LADDERING IN INITIAL PUBLIC OFFERINGS

By

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To my parents and my husband, Xi Li

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Laddering is a practice whereby the allocating underwriter requires the ladderer to buy additional shares of the issuer in the aftermarket as a condition for receiving shares at the offer price. This dissertation identifies factors that create incentives to engage in this type of manipulation, models the effect of laddering on initial public offering (IPO) pricing and the aftermarket price of IPO shares, and develops several empirical implications. First, laddering has a bigger effect on the market price of IPOs with greater expected underpricing (without laddering) and greater expected information momentum in the aftermarket. Second, profit-sharing between underwriters and their investor clients encourages laddering. Third, laddering increases the IPO offer price. Fourth, laddering may not aggravate the first-day return (i.e., (close–offer)/offer), depending on the relative magnitude by which the offer price and the first-day close price are boosted by laddering. Fifth, laddering contributes to long-run underperformance and creates a negative

correlation between short-run and long-run returns. Empirical tests based on IPOs from 1998-2000 support the model's predictions.

CHAPTER 1
INTRODUCTION

Laddering in initial public offerings (IPOs) refers to a practice whereby the allocating underwriter requires its customers to buy additional shares of the issuer in the aftermarket as a condition for receiving shares at the offer price. The customers who enter into a laddering agreement, also known as a tie-in agreement, are called "ladderers." The Securities and Exchange Commission (SEC) views laddering as a manipulative sales practice prohibited by Rule 101 of Regulation M under the Securities Exchange Act of 1934.[1] Examples of IPOs in which laddering occurred are given in the January 25, 2005 SEC settlement with Morgan Stanley and Goldman Sachs, in which the underwriters agreed to pay a total of $80 million to settle accusations of laddering, and the October 1, 2003 SEC settlement with J.P. Morgan Securities Inc., in which the underwriter agreed to pay a $25 million civil penalty.[2] As an outgrowth of these and other cases, stricter rules were proposed by the SEC to prohibit laddering in IPOs, among other practices (Bray and Gullapalli 2004). The National Association of Securities Dealers (NASD) views

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[1] Regulation M is designed to prohibit activities that could artificially influence the market for the offered security, including for example, supporting the IPO price by creating the perception of scarcity of IPO stock or creating the perception of aftermarket demand. With some excepted activities, such as the appropriate stabilizing activities permitted by Rule 104, Rule 101 prohibits underwriters from directly or indirectly bidding for, purchasing, or attempting to induce any person to bid for or purchase any offered security in the aftermarket during the applicable restricted period.

[2] U.S. SEC Litigation Release No. 19050 / January 25, 2005, SEC v. Morgan Stanley &Co. Inc., Civil Action No. 1:05 CV 00166 (HHK) (D.D.C.) is available at http://www.sec.gov/litigation/litreleases/lr19050.htm. U.S. SEC Litigation Release No. 19051 / January 25, 2005, SEC v. Goldman Sachs &Co, 05 CV 853 (SAS) (S.D.N.Y.) is available at http://www.sec.gov/litigation/litreleases/lr19051.htm. U.S. SEC Litigation Release No. 18385 / October 1, 2003, SEC v. J.P Morgan Securities Inc. Civil Action No. 1:03 CV 02028 (ESH) (D.D.C.) is available at http://www.sec.gov/litigation/litreleases/lr18385.htm.

laddering as violating NASD Conduct Rule 2110, which requires member firms to observe just and equitable principles of trade. Laddering may also violate other anti-fraud and anti-manipulation provisions of the federal securities laws.[3]

Why might laddering be in the interest of an underwriter? What is the impact of laddering on the IPO stock's offer price and aftermarket price? Laddering might be used by underwriters to support cold IPOs, and this has been a concern of the SEC for decades.[4] However, if SEC settlements are used as a proxy for the extent of laddering, why did laddering seem to be more severe during the late 1990s and early 2000, a period that witnessed extremely high first-day returns? Answering these questions would help us to understand the nature of this practice in IPOs. This dissertation presents a formal model to illustrate the laddering-related tradeoffs faced by an underwriter, and how laddering affects IPO pricing and the aftermarket price of IPO shares.

This study is of interest for at least two reasons. First, our study augments the IPO underpricing literature. Researchers have explored a variety of perspectives on the IPO process and provided theories explaining underpricing in IPOs. However, the record-shattering magnitude of underpricing during the bubble period of 1999-2000 needs further explanation. Both Ljungqvist and Wilhelm (2003) and Loughran and Ritter (2004) report that IPO underpricing exploded to an average of 65% in 1999-2000, and raise the question of what explains the severe underpricing during the internet bubble period. Loughran and Ritter (2004) argue that "spinning" and issuers' desire for research

[3] In Securities Exchange Act Release No. 6536 (April 24, 1961), the SEC also held that laddering agreements are fraudulent devices that violate Section 17 (a) of the Securities Act of 1933 and Section 10 (b) of the Securities Exchange Act of 1934, because they facilitate material omissions in connection with the offer or sale of securities. See, e.g., Richard D. Denaio, Initial Decision Release No. 37 (August 4, 1993), Securities Exchange Release No. 33062 (October 15, 1993).

[4] See *supra* note 3.

coverage contributed to the severe underpricing in 1999-2000. Intuitively, it seems that laddering could be another candidate explanation.

Aggarwal, Purnanandam, and Wu (2004) (hereafter APW) argue that laddering was a significant factor contributing to the extremely high level of first-day return witnessed in the bubble period. In contrast, both our model and empirical evidence suggest that laddering by itself may not increase the first-day return, because laddering could boost both the first-day closing price and the IPO offer price. It should be noted that there are currently no published empirical studies of laddering, partly because there are no publicly available data concerning buyers' specific allocations and aftermarket purchases. Even if the data were available, a researcher would have to know whether aftermarket purchases were undertaken with explicit or implicit agreements relating the purchases to IPO allocations.

The second reason for why this study is of interest is that our research extends the literature on stock price manipulation. Broadly speaking, two types of stock price manipulations are recognized: 1) action or trade-based manipulation, which is based on trading actions that change the actual or perceived value of the assets (Vila 1989, Bagnoli and Lipman 1990, Allen and Gale 1992, Allen and Gorton 1992, Kumar and Seppi 1992, Aggarwal and Wu In press);[5] and 2) information-based manipulation, which is based on releasing false information or spreading false rumors (Vila 1989, Benabou and Laroque 1992, Van Bommel 2003). Our model of laddering falls into the first category, since

[5] For example, in a practice named a "bear raid," manipulators engage in a concentrated bout of selling, inducing frightened investors to also sell and the price to fall, at which point the manipulators buy back stock to restore their original positions at a lower price.

laddering is intended to increase both the actual and perceived value of the IPO stock through the ladderer's aftermarket purchase.

In the stock price manipulation literature, a variety of non-mutually exclusive assumptions are used to make profitable speculation possible. One assumption is "price momentum"; i.e., when noise traders follow momentum strategies (i.e., buy when price rises and sell when prices fall), an increase in price at one date causes prices to increase at future dates. Expecting price momentum, the speculator could jump on the bandwagon and purchase ahead of noise trader demand (Jarrow 1992, De Long, Shleifer, Summers, and Waldmann 1990).

A second assumption is incomplete and asymmetric information. This could have the following two applications. First, investors are uncertain whether a large trader who buys the share does so because he knows it is undervalued or because he intends to manipulate the price. It is this pooling that allows manipulation to be profitable (Allen and Gale 1992, Kumar and Seppi 1992, Aggarwal and Wu In press). Second, sellers are more likely to be liquidity traders than buyers are, or buyers are more likely to be informed traders than sellers are. Based on this asymmetric information content of buy and sell orders, the uninformed market maker Bayesian updates his estimation about the true price, leading to an asymmetry in price responses, which makes profitable speculation possible (Allen and Gorton 1992).

A third assumption is a market corner by the speculator. This assumption allows the speculator to make a profit via a short squeeze later (Jarrow 1992).

Although the profitability of laddering is fundamentally related to the underpricing of IPO shares, it is also related to the first of these assumptions, "price momentum." [6] More importantly, in the IPO setting, the source of price momentum is more than just momentum traders. Aggarwal, Krigman, and Womack (2002) refer to price momentum in the IPO setting as "information momentum" and argue that the reason behind it is information production: the large run-up in the stock price on the first trading day attracts interest from research analysts and the media (Chemmanur 1993). Analysts provide more recommendations and research reports for the seemingly hottest IPOs. This enhanced coverage brings the stock to the attention of more investors, increasing the demand for the stock (Merton 1987, Barber and Odean 2003, and Zhang 2004). In this dissertation, we use "information momentum" and "price momentum" interchangeably.

Our model simplifies the information asymmetry aspect of laddering by assuming that the market does not know the existence of laddering, instead of assuming that the market assigns a probability to the entry of a manipulator, which is usually important for the discussion on seasoned stock price manipulation. Note that we do not intend to demonstrate the profitability of the ladderers' *aftermarket* transactions. Instead, we accommodate the possibility that selling the shares purchased in the aftermarket could cause a capital loss for the ladderers. We argue that the fundamental profitability of laddering is not from the shares purchased in the aftermarket; instead, it is from the shares purchased in the initial allocation. This is exactly why a laddering agreement ties

[6] We will show later that momentum is not a necessary condition for laddering to exist, contrary to APW. However, momentum is related to the extent of laddering and can help us to better understand when laddering could be more aggressive.

the initial allocation with the aftermarket share purchase promise. In this model, we want to focus on the unique aspect of laddering, as a type of IPO stock price manipulation.

The existing literature has extensively discussed the theoretical possibility of profitable speculation and the necessary technical conditions for *seasoned* stocks' price manipulation. This dissertation extends the literature to the area of *IPO* stock price manipulation and focuses on the *effect* of laddering on IPO pricing and the aftermarket price of IPO shares.

In our model, laddering could enrich the underwriter via two mechanisms. First, the buying pressure from laddering could boost the market price and reduce the underwriter's expected price support cost in the aftermarket. Second, the underwriter could benefit indirectly from laddering through rent-seeking behavior by its investor clients. If some investor clients pay the underwriter a portion of the profits that they make on underpriced IPO allocations, then some portion of the laddering-enhanced profits would be eventually funneled back to the underwriter.[7] Because of these relationships, we argue that laddering could influence the underwriter's decision on the offer price.[8]

Our model generates several important implications, which are supported by empirical evidence. First, in equilibrium, more expected underpricing and price

[7] As examples of the relevance of the assumption about the rent-seeking behavior by investor clients, see pages 8-9 in Loughran and Ritter (2004) and the references in their footnote 1. More generally, if underwriters allocate oversubscribed issues at least partially on the basis of commission revenue received from clients, then rent-seeking behavior will occur in competitive equilibrium, whether or not underwriters require explicit profit-sharing agreements. Evidence consistent with commission business affecting IPO allocations is contained in Reuter (2004) and Nimalendran, Ritter, and Zhang (2005). Further, Boehmer and Fishe (2004) analyze 1.56 million account allocations in a sample of 265 IPOs during 1999-2000 and find evidence consistent with the view that regular institutional clients provide something extra to the underwriter, which could be information about the IPO, trading commissions, or laddering agreements, etc.

[8] Consistent with Fulghieri and Spiegel (1992) and Loughran and Ritter (2002), the profitable initial allocations may only be available to investors who return a large portion of them to their underwriter via quid pro quo arrangements.

momentum could lead to more aggressive laddering. This is consistent with the evidence that 1999-2000 witnessed severe IPO underpricing and significant aftermarket price momentum (Aggarwal, Krigman, and Womack 2002, Bradley, Jordan, and Ritter 2003, Jaggia and Thosar 2004a, and the evidence presented here).[9] Hundreds of IPOs from this period have been sued for laddering.[10]

Second, profit-sharing between underwriters and their investor clients encourages laddering. This offers a further reason for why laddering seemed to be more severe during 1999-2000, a period when underwriters benefiting from rent-seeking behavior by their investor clients became a concern of the SEC.

Third, laddering tends to increase the offer price. This is consistent with the evidence in APW that IPOs sued for laddering have significantly higher offer prices than the non-sued IPOs, and sued IPOs are significantly more overvalued than non-sued IPOs based on the offer-price to fundamental value ratios.

Fourth, laddering by itself may not change the first-day return. This implication is contrary to the intuitively appealing belief that laddering increases the first-day return, and therefore is rather surprising. However, we argue that underwriters try to capitalize on laddering-induced price inflation by increasing the offer price. Therefore whether laddering aggravates the first-day return depends on the relative magnitude by which the

[9] The existing empirical evidence on price momentum in 1999-2000 is rather indirect. Jaggia and Thosar (2004a) document momentum for high-tech IPOs during 1/1998-10/1999. Table 4 of Aggarwal, Krigman, and Womack (2002) contains momentum evidence for the period of 1/1994-12/1999. Table IX of Bradley, Jordan, and Ritter (2003) documents evidence for the period of 1999-2000, if we interpret the analysts' initiations as a proxy for the information momentum. In Figure 2, we present direct evidence for 1985-2002.

[10] 2001 can be called "the year of the IPO lawsuits." In this year, more than 300 IPO laddering cases were filed against underwriters and the companies they took public in the late 1990s and in 2000. Almost all the sued IPOs are tech or internet firms, which were the hottest IPOs during the 1999-2000 IPO bubble period. See PricewaterhouseCoopers LLP 2001 Securities Litigation Study, which is downloadable from http://www.pwcglobal.com.

offer price and the first-day closing price are boosted by laddering. This suggests that laddering could have contributed to higher levels of the aftermarket price and the offer price during the bubble period. Thus, the huge first-day return could be mainly due to factors other than laddering. For example, Ljungqvist, Nanda, and Singh In press offer an investor sentiment-based explanation for IPO underpricing in hot markets. Our implication also suggests that laddering may not affect the statistical power of the regressions of first-day returns, because the magnitude of the first-day return may not be distorted by laddering significantly.

Fifth, by boosting the immediate aftermarket price, laddering contributes to long-run underperformance and a negative correlation between short-run and long-run returns. Note that the latter claim is not because laddering might drive up the short-term return. Rather, this is because there will be more laddering on IPOs that would have had high first-day returns without laddering.

Sixth, given that there is information momentum that is reflected in IPO stocks' aftermarket prices, it is unavoidable that ladderers would sell shares early instead of holding shares for the long term, especially in a hot IPO market, even if the underwriter tries to choose the ladderers who intend to be long-term investors ex ante. This is because the ladderers are aware that the stock price is temporarily inflated, and thus there will be negative long-run abnormal returns.

Our results can be compared with those in APW, which applies the model in Aggarwal and Wu In press to laddering.[11] Our model and APW's model have two similar predictions. First, laddering is more likely in a market with greater momentum.

[11] Aggarwal and Wu In press extend the model in Allen and Gale (1992) to incorporate momentum. The model is applied to a seasoned stock.

Second, the price of the IPO manipulated with laddering increases first and then drops as the market corrects it, therefore contributing to long-run underperformance and a negative correlation between short-run and long-run returns.

However, there are several major differences between the two models. First, in our model, unless the momentum effect is exploding, underpricing is a necessary condition for laddering to exist, because otherwise ladderers would not agree to purchase additional shares in the aftermarket in order to get IPO allocations. In other words, we model laddering as a tie-in agreement that bundles underpriced IPO allocation with unprofitable aftermarket purchase. In contrast, APW model laddering as bundling overpriced IPO shares with profitable aftermarket purchase. In their model momentum is a necessary condition for laddering to exist. Our model does not require price momentum.

Second, we model how laddering benefits the underwriter through its underwriting business, and derive the result that laddering increases the offer price in equilibrium. This prediction is consistent with the evidence in APW. Further, laddering by itself does not necessarily push the IPO offer price above the fundamental value of the stock. In APW's model, the underwriter pools together the high value stocks and the low value stocks, sets their offer price as the same (i.e., the average value), and manipulates the low value stock with laddering. This predicts that the IPO manipulated with laddering must have its offer price above its true value.

Third, our model predicts that laddering may not increase the first-day return significantly, because it boosts both the first-day close price and the offer price. This prediction is supported by our empirical tests, which are based on the IPO sample during 1998-2000, the period when IPOs subsequently involved in laddering litigation were

issued. We will summarize our main empirical findings next. In contrast, APW argue that laddering explains most of the unusually high level of first-day return during the same sample period.[12]

Using the laddering litigation as a proxy for the existence of laddering, we have two main empirical findings, consistent with our predictions. First, laddering does not explain the high level of the first-day return, after controlling for the endogeneity issue between the first-day return and laddering, market conditions, underwriter characteristics, issuer characteristics, and offer characteristics. Second, a greater first-day return leads to a greater probability of laddering, after controlling for the above factors. The results are robust to using the first-day opening return (i.e., (open–offer)/offer) to replace the first-day return, although the means/medians of the intraday returns (i.e., (close–open)/open) on the first trading day of IPOs during 1999-2000 are positive. The results shed light on the relations between laddering and IPO underpricing.

The remainder of this dissertation is organized as follows. The next chapter presents the basic model of laddering, solves the optimization problems for the underwriter under different scenarios without introducing information momentum, and then introduces and explains the role of information momentum in laddering. The third chapter generates the empirical implications of the model and discusses their empirical support. The fourth chapter describes the data and the methods used for our empirical tests. The fifth chapter reports the empirical results. The last chapter contains a brief

[12] Griffin, Harris, and Topaloglu (2004) find that block buying through bookrunners is swamped by small buying through non-syndicate members on the first day of super-hot IPOs (first-day return greater than 50%) during 1997-2002. If ladderers are the institutional investors who submit their block buy orders through the bookrunners, then the evidence in Griffin, Harris, and Topaloglu (2004) raises the question of what is the most significant factor behind the extremely high level of first-day returns during the bubble period.

summary. The proofs of all propositions are in Appendix A. The definitions of the variables in our empirical tests are in Appendix B. Appendix C has the details about how we construct the All-star dummy variable.

CHAPTER 2
THE MODEL

A Model of Laddering

We assume that the fundamental value of an IPO stock $\widetilde{V}$ is a random variable, and the IPO stock's equilibrium immediate aftermarket price $\widetilde{P}_E$ is a random variable that is positively related to $\widetilde{V}$ in the following fashion, $\widetilde{P}_E = s\widetilde{V}$, where s is positive and represents the investor sentiment. When investors are rational, $s = 1$. When investors have high sentiment, $s > 1$, and the IPO market is considered as a hot IPO market. We assume that $\widetilde{P}_E > \widetilde{V}$ could happen because of the restriction on short-selling. The underwriter could estimate the fundamental value of the stock based on some valuation methods. However, the underwriter cares more about the equilibrium aftermarket price, and tries to take advantage of the "window of opportunity" when $\widetilde{P}_E > \widetilde{V}$. We assume that $\widetilde{P}_E$ has a uniform distribution on the interval $[P_E - \frac{\Delta}{2}, P_E + \frac{\Delta}{2}]$. In other words, the mean and the standard deviation of $\widetilde{P}_E$ are P_E and $\frac{\Delta}{\sqrt{12}}$, respectively. We assume that P_E is unknown to the underwriter.

However, each informed investor has some information about P_E, because the informed investors' demand is representative of the aftermarket demand for the IPO stock. One purpose of the "road shows" is to invite the informed investors to participate

in the IPO and collect their information reports, based on which the underwriter could come up with an estimate of the mean of the equilibrium aftermarket price of the stock,

$$\hat{P}_E = P_E + \varepsilon \quad , \tag{1}$$

where ε is the estimation error, and it is a random variable with a zero mean and a non-zero variance. Note that $\hat{P}_E$ is an unbiased estimate,

$$E(\hat{P}_E) = P_E . \tag{2}$$

Without loss of generality, we assume that the more shares available to the informed investors, the more informed investors the underwriter could invite to participate in an IPO and collect information from, and the higher the accuracy of the estimate $\hat{P}_E$ that can be obtained. In other words, the variance of the estimation error is a decreasing function of the shares allocated to the informed investors,

$$\mathrm{var}(\varepsilon) = f(q_I) > 0 , \tag{3}$$

$f'(q_I) < 0$ and $f''(q_I) > 0$ for $q_I \in [0, Q_0]$. We assume that the function $f(q_I)$ is known to the underwriter and it could vary from one IPO to another. Presumably, $f(q_I)$ could be related to the characteristics of both the general IPO market as well as the issuing firm and the offer.

We consider the optimization problem of a risk-neutral underwriter, who has a laddering agreement with a risk neutral ladderer. The laddering agreement requires the ladderer to buy a certain number of shares in the aftermarket in order to get shares in the initial allocation (A typical laddering agreement recorded in indications of interest is of the form "will buy 2X in aftermarket" where X is the number of shares allocated at the offer price.). We also take into account the roles played by other IPO investors, including those who are endowed with private information about the aftermarket demand of the IPO stock that the underwriter does not know about ("informed investors"), and those

who share with the underwriter a portion of the profits they make by flipping the IPO shares in the aftermarket ("profit-sharers").[13]

For tractability, we assume that the three types of clients (ladderers, informed investors, and profit-sharers) are separate entities, who can not become another type of client in the short term. For example, a ladderer or a profit-sharer can not be considered as an informed investor, either because he does not have a comparative advantage at acquiring the information, or because the underwriter does not believe in his information. Also, a ladderer or an informed investor can not be a profit-sharer, since they do not have the capacity to offer any side benefits to the underwriter like the profit-sharer does. The underwriter allocates q_I, q_L, and q_K shares to the informed investors, ladderers, and profit-sharers, respectively. We have explained the informed investors at the beginning of this section, and will explain the other two types of IPO clients in more detail next.

The laddering agreement between the underwriter and the ladderer states that the ladderer should buy λ times the shares that he gets in the initial allocation. The underwriter determines the laddering purchase scalar λ. If λ>0, then $q_L > 0$; if $\lambda = 0$, then $q_L = 0$, i.e., there is no laddering. If the ladderer does not fulfill his promise, he could be blacklisted from future IPO allocations. This assumption is similar to that in Benveniste and Spindt (1989) regarding the underwriter's leverage over future profitable allocations. We assume that the profit from the future IPO allocations is tempting enough to prevent the ladderer from defaulting on the laddering agreement.[14]

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[13] We assume that the underwriter does not have enough market power to extract all of IPO profits from the profit-sharers. However, this assumption does not change our main results.

[14] Although a ladderer makes zero expected profit from laddering, laddering could somehow help a ladderer to build reputation with an investment banker and be possibly invited to participate in future IPOs as an informed investor, therefore making positive profits.

Profit-sharers share with the underwriter part of the profits they make by flipping the IPO shares in the aftermarket. We consider these clients in our model of laddering because they help to illustrate one of the benefits that laddering brings to the underwriter.

We assume that there is a downward sloping demand curve for stocks. We are assuming that investors are inherently heterogeneous in their valuations for stocks, in particular for new issues, consistent with Miller (1977), Rock (1986), and Benveniste and Spindt (1989). Although this assumption departs from the usual assumption that stocks are always priced at their fundamental value, there is plenty of empirical evidence of negatively sloped demand curves both for IPOs and in aftermarket trading. (Lewellen 2005, Cornelli and Goldreich 2001, 2003, Kandel, Sarig, and Wohl 1999, Table 4 of Wurgler and Zhuravskaya 2002 and the references therein).

The model makes several simplifying assumptions. We assume that other investors are price-takers. There are no transaction costs or taxes and the discount rate is zero. Furthermore, it is assumed that the equilibrium unconditional expected return on the stock in the aftermarket is zero. Figure 1 depicts the evolution of price over time for the model. The timing of the model is as follows.

At time 0: An underwriter takes a firm public, selling a fixed quantity of shares (Q_0) to the public at an offer price of P_0. Without loss of generality Q_0 is normalized to 1. The underwriter takes sequential actions at time 0. First it decides on how many informed investors to invite to participate in the IPO. Second, it collects information from them. Third, it sets the offer price. We will explain more about the sequential decisions in the next section.

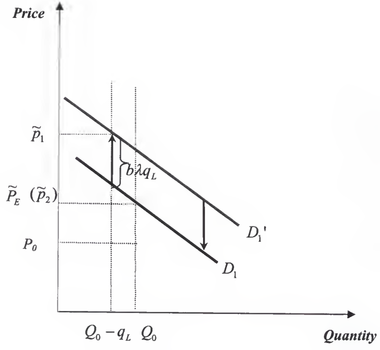

Figure 1. Evolution of Price. This depicts the evolution of price over time without information momentum. The market's demand curve for the IPO stock is denoted by D_1, and *-b* is the slope of the demand function, where *b>0.* The equilibrium market price of the IPO stock with Q_0 shares issued is assumed to be $\widetilde{P}_E$, without laddering. Once the IPO stock starts to trade, the ladderers withhold q_L shares, reducing the share supply from Q_0 to $Q_0 - q_L$, and buy λq_L shares at a price of $\widetilde{P}_1$. The artificial demand λq_L pushes the demand curve for the firm's stock outwards to D_1'. The ladderers then sells all their shares (i.e., $q_L + \lambda q_L$) at a price of $\widetilde{P}_2$. The supply curve shifts back to Q_0. The demand curve shifts inwards to D_1 due to the disappearing of the artificial demand.

At time 1: The IPO stock starts to trade. The market's demand curve for the IPO stock is denoted by D_1, and *-b* is the slope of the demand function, where *b>0.* Once the IPO stock starts to trade, the ladderers buy λq_L shares.

We argue that laddering has two effects on the aftermarket price of the IPO stock. First, by promising to purchase additional shares in the aftermarket, the ladderers also implicitly promise not to flip their IPO shares in the immediate aftermarket. This is

equivalent to reducing the aftermarket supply of the shares from Q_0 to $Q_0 - q_L$, which raises the aftermarket price by bq_L, given a downward sloping demand curve. Second, the ladderers' artificial demand λq_L boosts the demand curve for the firm's stock outwards to D_1' (see Figure 1), and inflates the immediate aftermarket price by $b\lambda q_L$.[15] Given the two effects of laddering on the aftermarket price, the price that the ladderers pay for their aftermarket shares is

$$\widetilde{P}_1 = \widetilde{P}_E + b(1+\lambda)q_L. \tag{4}$$

We will use P_1 to denote the expected value of $\widetilde{P}_1$. In the rest of the dissertation, we will refer to $\widetilde{P}_1$ as the *immediate aftermarket price*, and $\widetilde{P}_1 - \widetilde{P}_E$ or $b(1+\lambda)q_L$ as the *laddering-induced immediate aftermarket price inflation* or *price inflation.*

At time 2: The ladderers sell all their shares (i.e., $q_L + \lambda q_L$).[16] The price the ladderers could receive depends on whether time 2 represents the short term or long term. If time 2 is in the short term, then the supply and demand curves will shift back to their original positions due to the ladderers' relaxation of their share supply and the disappearance of their artificial demand. Hence, the price at which the ladderers sell all their shares is

$$\widetilde{P}_2 = \widetilde{P}_1 - b(1+\lambda)q_L = \widetilde{P}_E \ . \tag{5}$$

[15] Since every ladderer would want to buy shares in the aftermarket as early as possible, hopefully before other ladderers start to buy shares and push the market price up, they will all buy at time 1 and push the market price to the highest possible level they could.

[16] Similar to the logic in our footnote 15, since each ladderer would have an incentive to sell his own shares as soon as possible, hopefully before other ladderers' sales depress the price, we assume that the ladderers sell all their shares at time 2.

If time 2 is in the long term, when the market price reveals the fundamental value of the stock, then the price that the ladderers could receive is $\widetilde{P}_2 = \widetilde{V}$.

Note that ladderers would not prefer to hold shares for the long term, because selling in the short term makes no less profit than holding the shares for the long term. The ladderer's participation requirement is nonnegative profit from laddering:

$$E\widetilde{\Pi}_L = E\left[(\widetilde{P}_E - P_0) + (\widetilde{P}_E - \widetilde{P}_1)\lambda\right] \geq 0. \tag{6}$$

Note from (4) that with laddering we have $\widetilde{P}_E - \widetilde{P}_1 < 0$, which could be substituted into (6) and then yields $E(\widetilde{P}_E - P_0) > 0$. This tells us that expected underpricing is necessary for ladderers to participate.

In this dissertation, we differentiate the following terms. The extent of *underpricing* of an IPO stock is measured by $\frac{\widetilde{P}_E - P_0}{P_0}$, the difference between the equilibrium aftermarket price and the offer price relative to the offer price, and the *first-day return* (or *initial return*) is measured by $\frac{\widetilde{P}_1 - P_0}{P_0}$, the difference between the closing price on the first trading day and the offer price relative to the offer price. Without laddering, the first-day return could equal underpricing. However, they are different when laddering inflates the immediate aftermarket price above the equilibrium level. Further, in a hot IPO market where $\widetilde{P}_E > \widetilde{V}$, an IPO stock could be *overvalued* ($P_0 > \widetilde{V}$) while still underpriced ($P_0 < \widetilde{P}_E$).

In the next section, we will look at how laddering affects the underwriter's decision on the offer price.

The Underwriter's Decisions on Laddering in A Market without Momentum

Laddering not only has a direct effect on the IPO stocks' aftermarket price, but also indirectly influences the underwriter's decision on the offer price or underpricing. The purpose of this section is to investigate the influence of laddering on underpricing. To separate out the effect of information momentum on laddering or underpricing, in this section we assume that there is no information momentum in the IPO stock's aftermarket. In the next section, we will introduce information momentum into the model to see what difference it makes about laddering.

In this section, we will discuss the underwriter's decision on the offer price under different scenarios.[17] We will introduce laddering into two benchmark cases in which there is no laddering, and then investigate the effect of laddering. In the first benchmark case, we assume that there are no profit-sharers and that the primary motivation for the underwriter to embrace the laddering scheme is to reduce its expected aftermarket price support cost by increasing the immediate aftermarket price. In the second benchmark case, we assume that there are profit-sharers, who share part of their flipping profits with the underwriter, and that another motivation for the underwriter to embrace the laddering scheme is to enrich itself through profit-sharing by boosting the flipping profits.

The First Benchmark Case –without Profit-sharing

We define the first benchmark case as the situation when there is neither laddering nor profit-sharing. This setup tries to capture the stylized fact that a certain level of underpricing exists in equilibrium. From various perspectives, the IPO literature explains why equilibrium underpricing is needed to successfully underwrite an IPO. For example,

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[17] The issuing firm is implicitly regarded as a price taker.

underpricing is needed to induce IPO investors to truthfully report their private information (Benveniste and Spindt 1989), to compensate uninformed investors for the "winner's curse" problem (Rock 1986), to avoid a negative cascade (Welch 1992), etc. See Ritter and Welch (2002) for a review of the underpricing theories. All the underpricing theories share the common feature that the expected aftermarket price of the IPO stock affects the setting of the offer price. Without loss of generality, our benchmark case adopts a parsimonious underpricing model, which mathematically simplifies the explanation of underpricing as due to the underwriter's concern about the cost of aftermarket price support (Derrien 2005). This setup suppresses the mechanism that underpricing could come from other concerns, for example, to induce information truthfully.[18] However, it captures the fundamental characteristics of the relation between the expected aftermarket price and the offer price, and could help to illustrate the effect of laddering in a more straightforward fashion later. This case serves as a benchmark to compare with the cases in which laddering exists. Then in the next two subsections we will examine how laddering could affect the underpricing.

At time 0, the underwriter takes three actions sequentially. First, it decides on how many shares should be allocated to the informed investors, and sets the pricing schedule. Second, it collects information from the informed investors. Third, it sets the offer price. The underwriter is committed to providing price support on the secondary market until a time after time 1. Let's say it is time T. Figure 2 has a summary of the timing in this model.

[18] Although Derrien (2005) includes some constraints to explain how to allocate underpriced IPO shares to make the informed investors to truthfully report their information, underpricing is not a result of these constraints in his model.

Ladderer	Buys q_L at P_0	Buys λq_L at $\tilde{P}_1$		Sells $q_L+\lambda q_L$ at $\tilde{P}_2$
Time	0	1		2
Underwriter	- Sets q_I and the pricing schedule; - Collects information; - Sets P_0.	Price support starts if $\tilde{P}_1 < P_0$	Price support ends *before* time 2 with probability w	Price support ends *after* time 2 with probability 1-w

Figure 2. Timeline. This describes the actions of the underwriter and the ladderer over time.

In this benchmark the price at time T is the same as the price at time 1, i.e., $\tilde{P}_T = \tilde{P}_1$. Therefore, the underwriter maximizes its expected profit function at time 0 as:

$$\max_{P_0, q_I} E(\tilde{\Pi}_{U1}) \equiv E_{\hat{P}_E}\{cP_0 - E_{\tilde{P}_T}(\text{price support cost } | \hat{P}_E)\}, \tag{7}$$

where $\tilde{\Pi}_{U1}$ denotes the underwriter's profit, without laddering or profit-sharing. The first term in $\tilde{\Pi}_{U1}$, cP_0, is the underwriting commission (i.e., gross spread) revenue, where c is the commission as a fraction of the total proceeds and is assumed to be a constant. The second term in $\tilde{\Pi}_{U1}$, $E_{\tilde{P}_T}(\text{price support cost } | \hat{P}_E)$, is the expected cost of aftermarket price support given the realization of the random variable $\hat{P}_E$, which can be calculated as follows:

$$E_{\tilde{P}_T}(\text{price support cost } | \hat{P}_E) = \int_{\hat{P}_E - \frac{\Delta}{2}}^{P_0} (P_0 - \tilde{P}_T) g(\tilde{P}_T) d\tilde{P}_T = \frac{1}{2\Delta}\left[P_0 - (\hat{P}_E - \frac{\Delta}{2})\right]^2, \tag{8}$$

where $g(\tilde{P}_T)$ is the probability density function of $\tilde{P}_T$.[19]

Substituting (8) into (7) we have

[19] This form of price support is similar to that in Derrien (2005), and this assumption is somewhat extreme and is made for simplicity. The explanation is as follows. The cost of price support is zero if $\tilde{P}_T \geq P_0$ and is positive if $\tilde{P}_T < P_0$. In the latter situation, the underwriter buys the shares at P_0 and incurs a loss of $P_0 - \tilde{P}_T$.

$$\max_{P_0, q_I} E_{\hat{P}_E} \left\{ cP_0 - \frac{1}{2\Delta}\left[P_0 - (\hat{P}_E - \frac{\Delta}{2}) \right]^2 \right\}, \tag{9}$$

which can be rewritten as

$$\max_{P_0, q_I} \left\{ cP_0 - \frac{1}{2\Delta}\left[P_0 - (P_E - \frac{\Delta}{2}) \right]^2 - \frac{1}{2\Delta} f(q_I) \right\}. \tag{10}$$

Note that the last term in (10) represents a cost from price estimation inaccuracy, and is similar to the analysis on page 11 of Sherman and Titman (2002). As Yung (2005, p.330) comments in his footnote 4, "Sherman and Titman's analysis is reduced-form; the precise source of value behind price accuracy is suppressed." Here we offer an explanation for the source of value behind price accuracy and naturally introduce it into the objective function of the underwriter. Note that the tradeoff faced by the underwriter when allocating shares among different types of clients is between the loss of price estimation accuracy and the gain from having clients other than the informed investors to participate in an IPO, although other types of IPO clients do not exist in this benchmark case.

We neither specify the exact mechanism through which the information from the informed investors affects the estimated value of the stock, nor do we solve for the share allocations among the informed investors, because doing so could complicate the issue without providing additional insight beyond what Benveniste and Spindt (1989) have done. Rather, we only solve for the total shares allocated to the informed investors, and suppress the interaction between the underwriter and the informed investors, so that later we could highlight the interaction between the underwriter and the ladderers. However, based on the existing literature, we assume that the underwriter is able to guarantee truth-

telling by giving more favorable allocation to the informed investors who report positive information about the IPO.

In this benchmark case, only informed investors are available, and there are no ladderers or profit-sharers. Therefore, IPO shares will all be allocated to the informed investors, i.e.,

$$q_I^* = Q_0 . \tag{11}$$

In the next case, the underwriter will have both informed investors and ladderers available, and will need to decide whether shares should be allocated to the ladderers. Solving for the optimum offer price in (10) yields

$$P_0^* = P_E - \Delta(\frac{1}{2} - c) . \tag{12}$$

Obviously, the higher the expected aftermarket equilibrium price, the higher the optimum offer price; the higher the standard deviation of the aftermarket equilibrium price, the lower the optimum offer price. This expression captures the idea that IPOs with greater uncertainty regarding their aftermarket equilibrium price would be underpriced more.[20] Also note that the optimum offer price increases in the underwriting commission c, ceteris paribus. Since $c < \frac{1}{2}$, we know $P_0^* < P_E$; i.e., the expected underpricing is positive,

$$P_E - P_0^* = \Delta(\frac{1}{2} - c) > 0 . \tag{13}$$

The purpose of this setup is to provide a benchmark to this study. Next we will examine how laddering could affect the underwriter's decision on the offer price.

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[20] Please note that this is not a result of risk aversion, given a risk neutral underwriter in this model. Instead, uncertainty here is a measure of information asymmetry, consistent with the insight from Beatty and Ritter (1986).

Effect of Laddering without Profit-sharing

As analyzed before, laddering boosts the aftermarket price $\widetilde{P}_1$ by $(1+\lambda)bq_L$. The underwriter will provide price support until time *T*. However, ex ante it is not certain whether the ladderers will have unloaded their positions by time *T*. We assume that the ladderers have not sold their shares by time *T* with probability *w*. Hence, the expected price at time *T* is

$$\widetilde{P}_T = \widetilde{P}_E + w(1+\lambda)bq_L,$$

and the expected price support cost function is

$$E_{\widetilde{P}_T}(\text{price support cost } |\hat{P}_E) = \int_{\hat{P}_E + w(1+\lambda)bq_L - \frac{\Delta}{2}}^{P_0} (P_0 - \widetilde{P}_T) g(\widetilde{P}_T) d\widetilde{P}_T = \frac{1}{2\Delta}\left[P_0 - (\hat{P}_E + w(1+\lambda)bq_L - \frac{\Delta}{2})\right]^2.$$

We can write the underwriter's optimization problem with laddering as follows:

$$\max_{P_0, q_L, \lambda} E(\widetilde{\Pi}_{U2}) \equiv E_{\hat{P}_E}\{cP_0 - \frac{1}{2\Delta}\left[P_0 - (\hat{P}_E + w(1+\lambda)bq_L - \frac{\Delta}{2})\right]^2\}, \quad (14)$$

s.t.

$$q_I + q_L = Q_0, \quad (15)$$

$$E(\widetilde{\Pi}_L) = (P_E - P_0) + (P_E - P_1)\lambda \geq 0. \quad (6)$$

The underwriter's profit when there is laddering is denoted by $\widetilde{\Pi}_{U2}$. Similar to the profit function in (7), the first term in $\widetilde{\Pi}_{U2}$ is the underwriting commission revenue, and the second term in $\widetilde{\Pi}_{U2}$ is the expected aftermarket price support cost.

Note that the underwriter cannot prevent the ladderers from unloading shares in the short term, because the market price in the short term is no lower than the fundamental value of the stock, especially in a hot IPO market where the market price is higher than the fundamental value due to a higher investor sentiment. Even if the underwriter tries to

select the ladderers who could hold the shares for the long term, by using the expected fundamental value V in stead of the expected market price P_E in constraint (6), the ladderers' selling early is unavoidable. Therefore, the optimal choice for the underwriter is to use P_E in the constraint. Substituting (1) and (15) into (14) yields

$$\max_{P_0,\lambda,q_L} cP_0 - \frac{1}{2\Delta}\left[P_0 - (P_E + w(1+\lambda)bq_L - \frac{\Delta}{2})\right]^2 - \frac{1}{2\Delta} f(Q_0 - q_L)\,. \tag{16}$$

Solving the problem in (16) with the constraints gives the following proposition.

Proposition 1 (Necessary Conditions for Laddering): *Without information momentum, the following two conditions are necessary for laddering to exist. (1) The marginal value of the information from informed investors is below* $2cbw$*; (2) There is expected underpricing.*

The two necessary conditions for laddering to exist are obtained from the participation requirements of both the underwriter and the ladderers. The first necessary condition comes from the standpoint of the underwriter. When deciding whether to allocate shares to the ladderers, the underwriter is faced with the tradeoff between the loss of price estimation accuracy from having fewer informed investors to provide information, and the gain from laddering. When the marginal value of the information from informed investors is relatively high, the underwriter would not want to sacrifice price accuracy by doling out shares to ladderers. Since the marginal value of the information from informed investors decreases in the number of the participating informed investors, there is a point at which embracing laddering becomes worthwhile for the underwriter. The second necessary condition comes from the non-negative profit requirement by the ladderers in constraint (6).

Proposition 2 (Comparative Statics of Laddering): *Greater expected underpricing could lead to more aggressive laddering.*

The intuition behind Proposition 2 is that the more profitable the initial allocation is expected to be, the more attractive laddering is to the ladderers, and the more shares the ladderers have to purchase in the aftermarket in order to get underpriced IPO shares, because more lucrative initial allocation could offset more capital loss involved in the aftermarket purchase by the ladderers. This proposition implies that laddering could be more aggressive in a hot IPO market, especially in IPOs with greater uncertainty regarding its fundamental value.

The Second Benchmark Case – with Profit-sharing

In this subsection, we assume that profit-sharing between the underwriter and its investor clients (profit-sharers) is possible. Since the underwriter requires the profit-sharers to pay it a portion of the profit they make by flipping the IPO shares in the aftermarket, the underwriter's expected profit from profit-sharers can be derived as follows:

$$E_{\widetilde{P}_1}(\text{profit from profit - sharers } |\hat{P}_E)$$
$$= kq_k \int_{P_0}^{\hat{P}_E+\frac{\Delta}{2}} (\widetilde{P}_1 - P_0) g(\widetilde{P}_1) d\widetilde{P}_1 = \frac{kq_k}{2\Delta}\left(\hat{P}_E - P_0 + \frac{\Delta}{2}\right)^2, \tag{17}$$

where k is the percentage of the flipping profits that are shared with the underwriter. The profit-sharing fraction k is exogenous to the system of laddering in this dissertation.

As in Aggarwal and Wu (2004), we ignore the sellers' selling pressure on the price and model the market price as being mainly determined by the demand from buyers. In other words, we assume that the profit-sharers' flipping behavior has no impact on the market price, and the price they could receive depends on the demand from the buyers.

In this case, the underwriter needs to decide on the share allocation between the informed investors and profit-sharers and will maximize its profit function as follows:

$$\max_{P_0, q_k} E(\tilde{\Pi}_{U3})$$
$$\equiv E_{\hat{P}_E}\left\{cP_0 - E_{\tilde{P}_T}(\text{price support cost } |\hat{P}_E) + E_{\tilde{P}_1}(\text{profit from profit - sharers } |\hat{P}_E)\right\}, \quad (18)$$

s.t.

$$q_I + q_K = Q_0. \quad (19)$$

Substituting (1), (8) and (17) into (18) yields

$$\max_{P_0, q_k}\left\{cP_0 - \frac{1}{2\Delta}\left[P_0 - (P_E - \frac{\Delta}{2})\right]^2 + \frac{kq_k}{2\Delta}\left(P_E - P_0 + \frac{\Delta}{2}\right)^2 - \frac{(1-kq_k)}{2\Delta}f(Q_0 - q_K)\right\}. \quad (20)$$

Like in (13), the last term above captures the cost of price estimation inaccuracy. Investigating the condition for $q_k > 0$ yields the following proposition.

Proposition 3 (A Necessary Condition for Profit-sharing): *When the marginal value of the information from informed investors is below* $k\{[\Delta(1-c)]^2 + f(Q_0)\}$, *the underwriter would allocate shares to the profit-sharers.*

Similar to Proposition 1, when deciding whether to allocate shares to the profit-sharers, the underwriter is faced with the tradeoff between the loss of price estimation accuracy from having fewer informed investors to provide information, and the gain from profit-sharing. Only when the marginal value of the information from informed investors is relatively low, allocating shares to profit-sharers is worthwhile.

Effect of Laddering with Profit-sharing

In this subsection, we assume that both profit-sharing and laddering is possible. With laddering, the expected profit from profit-sharers can be calculated as follows:

$E_{\tilde{P}_1}(\text{profit from profit - sharers } |\hat{P}_E)$

$$= kq_k \int_{P_0}^{\hat{P}_E+(1+\lambda)bq_L+\frac{\Delta}{2}} (\widetilde{P}_1 - P_0)g(\widetilde{P}_1)d\widetilde{P}_1 = \frac{kq_k}{2\Delta}\left(\hat{P}_E + (1+\lambda)bq_L - P_0 + \frac{\Delta}{2}\right)^2. \tag{22}$$

Therefore, the underwriter's optimization problem is as follows:

$$\max_{P_0, q_L, \lambda, q_k} E(\widetilde{\Pi}_{U4})$$

$$\equiv cP_0 - \frac{1}{2\Delta}\left[P_0 - (P_E + w(1+\lambda)bq_L - \frac{\Delta}{2})\right]^2$$

$$+ \frac{kq_K}{2\Delta}\left(P_E + (1+\lambda)bq_L - P_0 + \frac{\Delta}{2}\right)^2 - \frac{1-kq_K}{2\Delta} f(Q_0 - q_K - q_L), \tag{23}$$

s.t.

$$q_I + q_L + q_k = Q_0, \tag{24}$$

$$E(\widetilde{\Pi}_L) = (P_E - P_0) + (P_E - P_1)\lambda \geq 0. \tag{6}$$

$\widetilde{\Pi}_{U4}$ denotes the underwriter's profit when it could have a laddering agreement with the ladderers and also receive profit from the profit-sharers. Like in (13) and (20), the last term in (23) captures the cost of price estimation inaccuracy.

We have examined four different scenarios in which the underwriter chooses the optimum offer price. Table 1 summarizes the four scenarios along two dimensions: laddering or no laddering and profit-sharing or no profit-sharing. Comparing all the four cases, we have the following propositions.

Proposition 4 (Effects of Profit-sharing): *Profit-sharing decreases the offer price regardless of whether there is laddering; the extent of laddering increases in the profit-sharing fraction k.*

Table 1. Summary of the Scenarios

	No profit-sharing	Profit-sharing
No laddering	$\max_{P_0,q_I} E(\widetilde{\Pi}_{U1}) \equiv cP_0 - \frac{1}{2\Delta}\left[P_0 - (P_E - \frac{\Delta}{2})\right]^2 - \frac{1}{2\Delta} f(q_I)$ (10)	$\max_{P_0,q_I,q_k} E(\widetilde{\Pi}_{U3}) \equiv cP_0 - \frac{1}{2\Delta}\left[P_0 - (P_E - \frac{\Delta}{2})\right]^2 + \frac{kq_k}{2\Delta}\left(P_E - P_0 + \frac{\Delta}{2}\right)^2 - \frac{(1-kq_k)}{2\Delta} f(Q_0 - q_K)$ (20)
Laddering	$\max_{P_0,q_I,q_L,\lambda} E(\widetilde{\Pi}_{U2}) \equiv cP_0 - \frac{1}{2\Delta}\left[P_0 - (P_E + w(1+\lambda)bq_L - \frac{\Delta}{2})\right]^2 - \frac{1}{2\Delta} f(Q_0 - q_L)\}$ (16)	$\max_{P_0,q_I,q_L,\lambda,q_k} E(\widetilde{\Pi}_{U4}) \equiv cP_0 - \frac{1}{2\Delta}\left[P_0 - (P_E + w(1+\lambda)bq_L - \frac{\Delta}{2})\right]^2 + \frac{kq_K}{2\Delta}\left(P_E + (1+\lambda)bq_L - P_0 + \frac{\Delta}{2}\right)^2 - \frac{1-kq_K}{2\Delta} f(Q_0 - q_K - q_L)$ (23)

This table summarizes the four scenarios examined. $\widetilde{\Pi}_{U1}$ denotes the underwriter's profit, without laddering or profit-sharing. The first term in $E(\widetilde{\Pi}_{U1})$ is the underwriting commission (i.e., gross spread) revenue, and c is the commission as a fraction of the total proceeds. The second term is the expected aftermarket price support cost. The last term represents a cost from price estimation inaccuracy. $\widetilde{\Pi}_{U2}$ denotes the underwriter's profit, with laddering but without profit-sharing. $\widetilde{\Pi}_{U3}$ denotes the underwriter's profit, with profit-sharing but without laddering. The third term in $E(\widetilde{\Pi}_{U3})$ is the profit from the profit-sharers, and k is the profit shared with the underwriter as a fraction of the profit made by the profit-sharers on underpriced IPO allocations. $\widetilde{\Pi}_{U4}$ denotes the underwriter's profit, with both laddering and profit-sharing. b denotes the absolute value of the demand curve and λq_L denotes the number of shares purchased by the ladderers in the aftermarket.

The intuition behind this proposition is that profit-sharing, as a money transferring channel, could motivate the underwriter to decrease the offer price in order to extract more rent from the profit-sharers. This effect of profit-sharing on the offer price holds true regardless of the existence of laddering. Further, as the profit-sharing fraction k increases, laddering becomes more severe, because when more rent can be extracted by the underwriter, the offer price will be decreased more, which feeds laddering to a greater extent.

Proposition 5 (Effects of Laddering): *Laddering increases the offer price regardless of whether there is profit-sharing; laddering will increase(decrease) the first-day return if* $w < (>) \frac{P_0}{P_E}$.

The intuition behind this proposition is that laddering could increase the expected immediate aftermarket price and reduce the expected price support cost, therefore essentially encouraging the underwriter to increase the offer price. The underwriter tries to capitalize on the expected laddering induced price inflation, and therefore factoring it into the offer price setting.

The proposition also states that the negative effect of laddering on underpricing exists regardless of whether there is profit-sharing. However, this does not mean that profit-sharing has no impact on laddering. Indeed, Propositions 4 and 5 imply that profit-sharing encourages laddering in that profit-sharing aggravates underpricing, which feeds laddering. Further, the higher the profit-sharing fraction, the greater are the benefits to the underwriter of boosting the aftermarket price through laddering.

This proposition implies that laddering does not necessarily increase/decrease the first-day return, because it increases both the offer price and the aftermarket price. This

implication comes as a surprise on the first glance, since it suggests that the huge first day return during the bubble period may not be due to laddering. However, the reason is not counterintuitive. Only when the first-day price is increased sufficiently higher than the offer price is increased (i.e., w is sufficiently small), could the first-day return be increased by laddering.

Given the opposite effects of laddering and profit-sharing on the offer price, their joint effect on underpricing could be either positive or negative, depending on the relative strength of the two effects. However, comparing the underwriter's profit functions in (14) and (22), it is obvious that profit-sharing provides the underwriter a second way to benefit from laddering. This implies that with profit-sharing, the underwriter has greater incentive to embrace the laddering scheme.

Information Momentum and Laddering

In this section we will introduce information momentum and discuss how it affects laddering and underpricing. We will start with explaining the mechanism behind information momentum. When IPO stocks start to trade, positive first-day returns attract the media's attention and, following Merton (1987), induce more demand from investors, which we call information momentum. Therefore, the demand curve will be shifted outward and the market price will increase. The ladderers then exploit this additional demand when they unwind their positions.

We use $M(\Delta\widetilde{P})$ to stand for the momentum effect, where $\Delta\widetilde{P}$ is the first-day return, i.e., $\Delta\widetilde{P} = \widetilde{P}_1 - P_0$. The momentum effect is assumed to be increasing, $M'(\Delta\widetilde{P}) > 0$, for $\Delta\widetilde{P} > 0$. We also assume that if there is no initial return, there is no momentum effect,

i.e., if $\Delta\widetilde{P} \leq 0$ then $M(\Delta\widetilde{P}) = 0$. For simplicity, we assume $M(\Delta\widetilde{P})$ to be a simple linear function in price change when $\Delta\widetilde{P} > 0$, and truncated at zero when $\Delta\widetilde{P} \leq 0$, i.e.,

$$M(\Delta\widetilde{P}) = \begin{cases} m\Delta\widetilde{P}, & \text{if } \Delta\widetilde{P} > 0 \\ 0, & \text{otherwise,} \end{cases}$$

where m is the momentum effect scalar, and $m>0$.

When there is information momentum, the ladderers' participation constraint becomes

$$E\widetilde{\Pi}_L = E\left\{[\widetilde{P}_E + M(\Delta\widetilde{P}) - P_0] + [\widetilde{P}_E + M(\Delta\widetilde{P}) - \widetilde{P}_1]\lambda\right\} \geq 0. \tag{25}$$

Everything else being the same, each ladderer's profit per share is increased by $(1+\lambda)M(\Delta\widetilde{P})$ due to information momentum. This has two implications. First, with information momentum ladderers would prefer selling the shares early instead of holding the shares for the long term, even if the IPO market is not hot. Second, the optimum λ and q_L would be increased accordingly. In other words, greater expected information momentum could aggravate laddering.

Proposition 6 (Information Momentum and Laddering): *Laddering increases in the information momentum effect scalar m.*

When the magnitude of the expected momentum effect scalar m is over a certain level, the ladderers' aftermarket purchase could be profitable by itself, and there is no need to tie the aftermarket purchase with any profitable initial allocation. Therefore, we do not consider the case when the momentum effect scalar is too high. As a complement, the model in Aggarwal, Purnanadam, and Wu (2004) focuses on the case where the ladderer's aftermarket purchase itself could be profitable.

Laddering not only increases in information momentum, it also helps to increase the magnitude of the momentum effect for the following reason. The ladderers' temporary restriction of share supply and immediate aftermarket purchases inflate the IPO stock's market price, creating a greater first-day return, which in turn generates greater information momentum and shifts the demand curve for the firm's stock outwards more than without laddering. With information momentum, we argue that time 2 could be the time when the IPO quiet period expires, the underwriter's analysts start to make their recommendations and some investors, especially naïve individuals, start to buy shares (Bradley, Jordan, and Ritter, 2003).[21] Ladderers choose to sell at this time in order to take advantage of the momentum effect.

Information momentum also has some implications for IPO underpricing. As Proposition 6 suggests, information momentum increases the magnitude of laddering. Since laddering increases the IPO offer price, we know that laddering with information momentum will increase the offer price more than without information momentum. This tells us that laddering can help the underwriter and the issuing firm to capitalize on the information momentum by obtaining higher proceeds. Therefore, in a hot IPO market with high information momentum, laddering could make an IPO offer price much higher than its true value without reducing the first-day return.

[21] Malmendier and Shanthikumar (2005) find that small traders do not account for the upward bias of analysts' stock recommendations and exert significantly positive pressure for "buy" recommendations. During the late 1990s, naïve investors' buying at the analysts' recommendations was anticipated by some institutional traders. Puckett, Irvine, and Lipson (2004) document "abnormally large institutional buying imbalances beginning five days before initial recommendations are publicly released", and conclude that "some institutional traders receive tips regarding the content of the soon to be released analysts' report."

CHAPTER 3
EMPIRICAL IMPLICATIONS

We now summarize the empirical implications of the model, relating them to the existing evidence and suggesting further empirical tests.

Implication 1: The greater the extent of expected underpricing, the greater the number of shares that could be purchased by the ladderer in the aftermarket, and the greater the magnitude of the laddering-induced immediate aftermarket price inflation. This is consistent with the general pattern of the bookrunners' clients trading activity on the first day of IPO reported by Griffin, Harris, and Topaloglu (2004). In Table 6, they report that bookrunners' clients net buying volume on the first day of IPO as a percentage of the total shares issued generally increases in the first day return.

Comparing the levels of underpricing and laddering settlement over time, this implication is also consistent with the evidence that 1999-2000 witnessed severe underpricing (Ljungqvist and Wilhelm 2003, Loughran and Ritter 2004), and that a large number of IPOs during that period have been involved with SEC settlements for laddering.

In the next section we will empirically test this prediction. However, there could be an endogeneity problem between laddering and initial return. On the one hand, IPOs with greater underpricing could have a higher probability of laddering. On the other hand, laddering could lead to greater initial return, if the aftermarket price is increased much more than the offer price is increased by laddering. We will control for this endogeneity problem in our empirical tests.

A more basic question is why there was greater underpricing during 1999-2000 in the first place. We argue that this question is answered by Loughran and Ritter (2004). By examining the changing risk composition hypothesis, the realignment of incentives hypothesis, and the changing issuer objective function hypothesis to explain the severe underpricing in 1999-2000, they find supporting evidence for all the three hypotheses, with the last hypothesis explaining most of the increased underpricing.[22]

Implication 2: The greater is the information momentum effect, the greater is the number of shares that could be purchased by the ladderer in the aftermarket, and the greater will be the magnitude of the price inflation. The role of momentum is different than that of underpricing in that expected underpricing is necessary for laddering to exist, while momentum is not. However, momentum could push laddering to a level that might not be achieved by underpricing alone. We conjecture that momentum is a major factor that fed laddering during the late 1990s and early 2000.

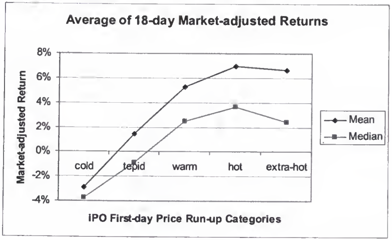
If we assume that greater analyst coverage could contribute to a greater information momentum effect, then active laddering could be associated with greater analyst coverage. Consistent with this conjecture, Bradley, Jordan, and Ritter (2003) report a general increase in the number of analysts' initiations at the end of the quiet period from 1996 to 2000. They state that firms going public in 1999-2000 specifically sought multiple managing underwriters in order to increase the amount of analyst coverage. If

[22] The changing risk composition hypothesis, introduced by Ritter (1984), implies that if the proportion of risky IPOs increases, there should be greater average underpricing. The realignment of incentives hypothesis, introduced by Ljungqvist and Wilhelm (2003), argues that changes during 1999-2000, including reduced CEO percentage ownership, fewer IPOs containing secondary shares, etc. made issuing firm decision-makers less motivated to bargain for a higher offer price. The changing issuer objective function hypothesis, developed by Loughran and Ritter (2004), predicts that the issuing firms became more willing to accept underpricing because of an increased focus on analyst coverage and side payments received by issuing firm executives (i.e., spinning).

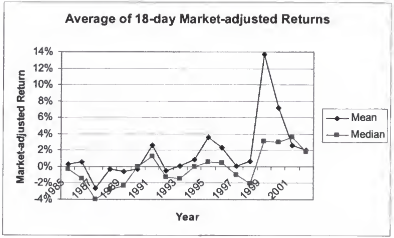
we interpret analysts' initiations as a proxy for information momentum, then this could be considered as evidence for a greater price momentum during 1999-2000. However, it is an empirical question whether the information momentum effect increases in the number of managing underwriters and their analysts' coverage.

We document some empirical evidence on price momentum in the aftermarket trading of IPOs during 1985-2002 in Figure 3. The historical averages of the value-weighted Nasdaq Composite (including distributions) adjusted returns over the first 18 trading days are plotted in seven panels.[23] Panel A demonstrates that the 18-day adjusted return increases in IPOs' first-day return. Panel B shows the time-series of the average 18-day adjusted returns during 1985-2002. It is obvious that the average level was higher during 1999-2000 than before. Panels C, D, E, F, and G break down Panel B into five categories of IPOs' first-day return: cold (first-day return ≤ 0), tepid ($0<$ first-day return $\leq 10\%$), warm ($10\%<$ first-day return $\leq 30\%$), hot ($30\%<$ first-day return $\leq 60\%$), and extra-hot (first-day return $>60\%$). Comparing across the five panels, we see that in general the adjusted return over the first 18 trading days increases over time in the first-day return, except for the extra-hot IPOs.

[23] The quiet period lasts for 25 calendar days or approximately 18 trading days post IPO during our sample period. Hence, we choose the 18 trading day return to measure information momentum. Jaggia and Thosar (2004b) study the 6-month market adjusted return post IPO for high-tech IPOs during 1998-1999 and find that a local peak is reached around 20 trading days post IPO.

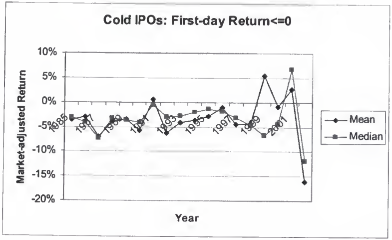


Panel A. Cross-sectional Average

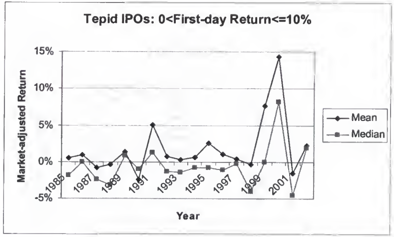


Panel B. Time-series Average

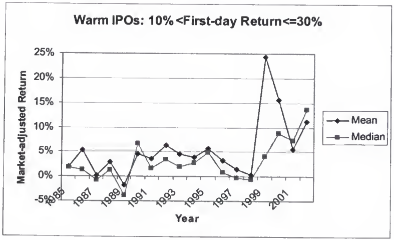
Figure 3. Historical Average of the Value-weighted Nasdaq Composite (including Distribution) Adjusted Returns over the First 18 Trading Days during 1985-2002. Closing prices are from the CRSP database. The original IPO sample is from Jay Ritter's IPO database. ADRs, units, spinoffs, reverse LBOs, the stocks with an offer price of no more than $5, and the stocks that do not have the relevant prices in the CRSP database are eliminated, leaving a final sample of 4,411 IPO stocks during 1985-2002. For year j, the average of the value-weighted Nasdaq Composite adjusted returns over the first 18 trading days after the offer date is measured as $\sum_{i=1}^{T_j}\left(\frac{P_{i,18}}{P_{i,1}}-\frac{M_{i,18}}{M_{i,1}}\right)$, where T_j refers to the total number of IPOs in year j, and $M_{i,18}$ and $M_{i,1}$ refer to the Nasdaq Composite levels (including distributions) on the 18^{th} and the 1st trading days for stock i, respectively. Although dividends on IPOs are not included, fewer than 1% of IPOs paid a dividend during the first 18 trading days. A) Cross-sectional Average. B) Time-series Average. C) Cold IPOs. D) Tepid IPOs. E) Warm IPOs. F) Hot IPOs. G)Extra-hot IPOs.



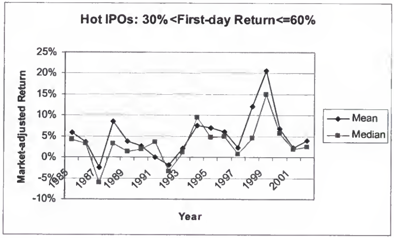
Panel C. Cold IPOs



Panel D. Tepid IPOs

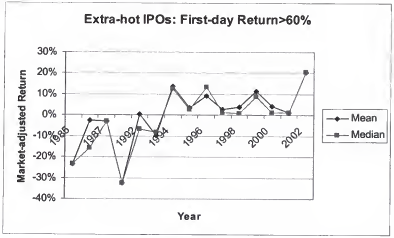


Panel E. Warm IPOs



Panel F. Hot IPOs

Figure 3. Continued



Panel G. Extra-hot IPOs

Figure 3. Continued

We further decompose the first-day return into two components: the opening return and the intraday return. The former is defined as the difference between the opening price on the first trading day and the offer price as a percentage of the offer price, and the latter is defined as the difference between the closing and opening prices as a percentage of the opening price on the first trading day. Figure 4 plots the average intraday return on the first trading day for the IPOs during 1993-2002. The daily opening and closing prices are from the NYSE TAQ database, whose coverage starts in 1993. We find that the median intraday return on the first trading day was zero during 1993-1998, but became significantly positive in both 1999 and 2000, and then gradually disappeared during 2001-2002. [24] It is puzzling that the mean and median of the first-day intraday return could stay positive for about two years without being exploited away.

In Figure 5, we divide the IPO sample into two sub-samples based on whether the issuing firm has been sued for laddering in a class action case.[25] We find that a significant part of the positive intraday return came from the sued IPO sample. If we use the laddering class action lawsuit as a proxy for the existence of laddering, although there is an obvious endogeneity problem with doing so, then this result is consistent with the story that the ladderers' aftermarket purchases might have contributed to the first-day intraday return. However, the true source of the observed intraday return is not known yet, and the positive intraday return could be due to other reasons, such as the purchases by the sentiment investors or the momentum investors.

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[24] This is consistent with Barry and Jennings (1993), who find that the median first-day intraday return was zero over the period December 1988 through December 1990.

[25] The sued IPO sample is available from the *Stanford Law School Securities Class Action Clearinghouse* (in cooperation with Cornerstone Research) website at http://securities.stanford.edu.

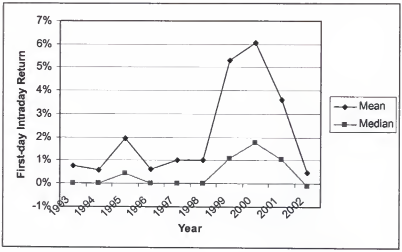
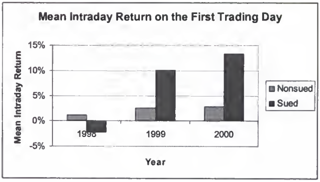
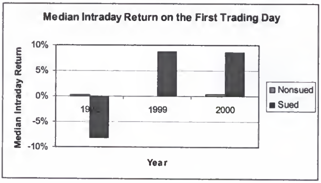


Figure 4. Time Series Average Intraday Return on the First Trading Day of IPOs during 1993-2002. Intraday return = (Close-Open)/Open. Trading price data are from the NYSE TAQ database. The original IPO sample is from Jay Ritter's IPO database. ADRs, units, spinoffs, reverse LBOs, and the stocks that do not have data in the TAQ database are eliminated, leaving a final sample of 3,190 IPO stocks during 1993-2002. For comparability with Barry and Jennings (1993), we do not screen the sample by the offer price. The offer price range is \$3-\$53 in our sample, as compared with \$1-\$30 in Barry and Jennings (1993). However, screening our sample by \$5 offer price threshold does not materially change the results because only 62 IPOs in our final sample have an offer price below \$5. The median intraday returns in 1999 and 2000 are positive at significance levels of less than 1% for both the sign test and the Wilcoxon signed rank test. The median intraday returns in 1995 and 2001 are positive at a significance level of less than 10% for both the sign test and the Wilcoxon signed rank test.



Panel A. Mean Intraday Return on the First Trading Day of IPOs during 1998-2000



Panel B. Median Intraday Return on the First Trading Day of IPOs during 1998-2000

Figure 5. Average Intraday Return on the First Trading Day of Sued vs. Non-sued IPOs during 1998-2000. Intraday Return = (Close-Open)/Open. Opening price data are from NYSE TAQ database. Closing price data are from CRSP database. The original IPO sample is from Jay Ritter's IPO database. ADRs, units, spinoffs, reverse LBOs, REITs, closed-end funds, S&Ls, stocks that do not have data in the TAQ or NYSE databases, and stocks whose first trading dates from the CRSP and the TAQ databases are different are eliminated, leaving a sample of 932 IPO stocks during 1998-2000. Among these IPOs, the numbers of sued firms are 7, 136 and 90 in 1998, 1999, and 2000 respectively, and the numbers of nonsued firms are 223, 254, and 222 in 1998, 1999, and 2000 respectively.

Implication 3: Laddering tends to increase the IPO offer price. This is mainly due to the reduced expected price support cost. Our model implies that in a hot market, an underpriced IPO could be overvalued, and laddering could make it more overvalued. Consistent with these predictions, APW report that IPOs that are sued for laddering are significantly more overvalued than non-sued IPOs, based on the offer-price to

fundamental value (P/V) ratios such as the Price-to-Sales ratio and the Price-to-EBITDA ratio. Figure 6 plots the results reported in APW.

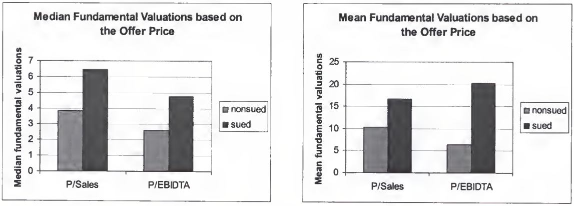


Figure 6. Fundamental Valuations for Sued vs. Non-sued IPO Firms during 1998-2000. This figure plots the results in Table 6 of APW.

Implication 4: Laddering may not change the first-day return significantly. This is because underwriters try to capitalize on laddering induced price inflation by increasing the offer price accordingly. This suggests that laddering could contribute to the higher levels of aftermarket price and offer price during the bubble period. However, the huge return on the first day might be due to factors other than laddering. For example, exuberant investor sentiment could be part of the explanation, as modeled by Ljungqvist, Nanda, and Singh In press. Griffin, Harris, and Topaloglu (2004) find that on the first trading day of IPO during 1997-2002, small trades occupy a much higher percentage of the total shares issued than large trades and reveal a net buy pattern in super-hot IPOs, lending support to the investor sentiment based explanation. Our implication also suggests that laddering may not affect the statistical power of the regressions of first-day returns, because the magnitude of the first day return may not be distorted by laddering significantly.

This implication suggests further empirical tests on whether laddering explains the huge first-day return during the bubble period. However, there is an endogeneity problem between laddering and first-day return, as explained before. Similar to Implication 1, we will control for the potential endogeneity problem in our empirical tests.

Implication 5: Profit-sharing could encourage laddering for two reasons. First, the extent of laddering is positively related to the extent of underpricing without laddering, and profit-sharing increases the extent of underpricing, which is corroborated by the evidence of Loughran and Ritter (2004). Hence laddering could be more severe with profit-sharing. Second, profit-sharing helps the underwriter to capitalize on the price inflation induced by laddering. In other words, besides reducing the expected price support cost, there is another motivation for the underwriter to embrace the laddering scheme: to enrich itself by requiring some profit-sharers to pay it a portion of the profits they make by flipping the IPO shares in the aftermarket. This offers a further reason for why laddering seemed to be more severe during the late 1990s and early 2000, a period when underwriter benefiting from rent-seeking behavior by its investor clients became a concern of the SEC.

Why would issuers put up with a greater extent of underpricing motivated by the profit-sharing between the underwriter and its clients? Loughran and Ritter (2004) provide two explanations, the "analyst lust" explanation and the "spinning" explanation. The analyst lust explanation states that analyst coverage is valuable to issuers, and is provided at a significant cost by investment bankers. Since these costs are covered partly by charging issuers explicit (gross spread) and implicit (underpricing) fees, issuers could purchase the analyst coverage by underpricing. The spinning explanation further explains

why underpricing rather than a higher gross spread is used to purchase research coverage. Spinning refers to a practice whereby some hot IPO shares are allocated to the executives of issuing firms and their venture capitalists through personal brokerage accounts. Since these decision-makers could share the profit from underpriced IPOs and this type of profit-sharing is less transparent, the situation where underpricing is used as currency to purchase analyst coverage arises.

How would laddering affect the issuing firm's interests? Without profit-sharing, laddering tends to increase the offer price. Therefore, the issuing firm could benefit from laddering by obtaining higher proceeds than without laddering. With both profit-sharing and laddering, the offer price could be either increased or decreased. In the latter case, the issuing firm could be worse off due to lower proceeds. However, if follow-on offerings could be issued while the momentum effect is still keeping the market price high, the issuing firm might be able to recover the reduced IPO proceeds through follow-on offerings. The logic is the same as that of the Loughran and Ritter (2004)'s analyst lust hypothesis.

Implication 6: Laddering artificially boosts the first-day price above the equilibrium level without laddering, therefore contributing to long-run underperformance and a negative correlation between the short-run and long-run returns documented in the IPO literature.

Implication 7: In a market where securities are overvalued, laddering could drive the stock price further away from its fundamental value and increase price volatility to a greater extent, therefore bringing more economic damages to investors and triggering lawsuits over laddering more easily. This implication offers a further explanation for why

the number of lawsuits over laddering against IPOs issued during 1999-2000 reached a record-shattering level.

Implication 8: Given information momentum in IPO stocks' aftermarket, ladderers tend to sell shares early instead of holding shares for the long term, regardless of whether the underwriter tries to choose the ladderers who intend to be long-term investors ex ante. This implication is in contrast with the argument by some investment bankers that laddering helps them to place shares in the hands of long-term investors.

CHAPTER 4
DATA AND METHODS

The Data

Data on IPOs from 1998 to 2000 are obtained from Jay Ritter's IPO database, which has made numerous corrections and additions to Thomson Financial's Securities Data Company (SDC) new issues database. His updated Carter-Manaster (1990) underwriter reputation measure is also used (the ranks are downloadable from his website at http://bear.cba.ufl.edu/ritter/Rank.htm). IPOs that have been sued for laddering in class action cases are identified from the *Stanford Law School Securities Class Action Clearinghouse* (in cooperation with Cornerstone Research) website at http://securities.stanford.edu. In addition, we also collect daily price and volume data from the CRSP database, intraday trade data from the NYSE TAQ database, all-America research team data from *Institutional Investor*, GICS (Global Industry Classification Standard) codes from the Compustat database, IPO industry classification and lead underwriter analyst name information from the *Investext Plus* database, and court dockets from both the *Stanford Law School Securities Class Action Clearinghouse* website and the *IPO Securities Litigation* website at http://www.iposecuritieslitigation.com.

We eliminate the IPO firms that have been sued for reasons unrelated to laddering, based on the court dockets. Therefore, non-sued firms in this dissertation refer to firms that are not sued for violations relating to the IPO during the sample period. We further eliminate ADRs, units, spinoffs, reverse LBOs, REITs, closed-end funds, and S&Ls from

both sued and nonsued firms, leaving a sample of 1,036 operating firm IPOs from 1998-2000.

Summary Statistics

Table 2 breaks down the operating firm IPO sample based on the IPO year, whether the stock is traded on NASDAQ, whether the firm is a tech firm, and whether the firm is an internet firm. Note that 65% and 86% of the IPOs during 1998-2000 are tech firms and traded on NASDAQ, respectively. The ratios are even higher for sued IPOs. About 91% and 99% of the sued IPOs are tech firms and traded on NASDAQ, respectively. Among the 1,036 operating firms that went public during 1998-2000, 288 firms (28%) have been sued for laddering and 748 firms (72%) have not. Among the sued firms, most (98%) of them went public during 1999-2000.

Table 2. Distribution of the IPO Sample Firms across IPO Years, Exchanges, and Industries

Year	**1998**	**1999**	**2000**	**Total**
Sued	7	171	110	288
Not sued	233	270	245	748
Market	**NASDAQ**	**Others**		**Total**
Sued	285	3		288
Not sued	611	137		748
Tech	**Tech**	**Others**		**Total**
Sued	263	25		288
Not sued	415	333		748
Internet	**Internet**	**Others**		**Total**
Sued	185	103		288
Not sued	225	523		748

The sample consists of 1,036 IPOs from 1998 to 2000, excluding ADRs, Units, Spinoffs, Reverse LBOs, REITs, Closed-end Funds, and S&Ls.

Next, we calculate the first-day return ((close-offer)/offer), using the closing price from the CRSP database, and the opening return ((open-offer)/offer), using the opening price from the TAQ database. We eliminate stocks that do not have data in the CRSP or

TAQ databases and stocks with different first trading dates on the CRSP and TAQ databases, leaving a sample of 927 IPO stocks.

Table 3 provides descriptive statistics on the sued and nonsued firms. The sued firms have a significantly higher first-day return than the nonsued firms. After decomposing the first-day return into the opening return and the intraday return on the first trading day, we still find that both components are significantly higher for the sued IPOs than for the nonsued IPOs. We conjecture that there could be two non- mutually exclusive sources for the higher intraday returns on the first trading day: the price impact of aftermarket share purchases by ladderers and investors' bullish sentiment for hot IPOs.

We also compare the sued firms and nonsued firms regarding share turnover and the standard deviation of returns. We define turnover as

$$turnover = \tfrac{1}{90}\sum_{t=1}^{90}(volume\ traded_t \,/\, total\ shares\ outstanding_t), \qquad (26)$$

where t is the trading day. Consistent with prior studies, we adjust for the NASDAQ volume definition by dividing NASDAQ volume by a factor of two. We find that sued firms have a significantly higher turnover and standard deviation of returns than nonsued firms.

Furthermore, the sued IPOs and the non-sued IPOs exhibit many other different characteristics. First, sued firms have a significantly higher offer price revision than the nonsued firms, where the offer price revision is defined as the percentage difference between the midpoint of the original price range filed with the SEC and the offer price. Second, sued firms have significantly higher ranked underwriters than nonsued firms. This finding is consistent with the "deep pocket" theory of lawsuits. Third, sued IPOs have more managing underwriters, a higher percentage of VC backed firms, tech firms,

internet firms, and purely primary share offers. Last, sued firms on average have a younger age, less assets and sales, and more negative EPS than the nonsued firms.

Although Table 3 demonstrates some univariate differences between the sued and nonsued firms, these differences could be correlated. Therefore, we would not want to over-interpret the univariate differences here. Next, we will use two-stage multivariate regressions to investigate the relation between first-day return and laddering litigation.

Table 3. Characteristics of Sued vs. Non-sued IPO Sample Firms during 1998-2000

	P-value	Sued IPO Firms				Non-sued IPO Firms			
	(Wilcoxon or Pearson)	N	Mean	Median	Std. Dev.	N	Mean	Median	Std. Dev.
Initial return	<0.01%	244	131%	100%	1.04	683	25%	11%	0.45
Opening return	<0.01%	244	115%	89%	1.11	683	22%	8%	0.36
Intraday return	<0.01%	244	11%	9%	0.25	683	2%	0%	0.16
Offer price	<0.01%	244	16.73	16	5.22	683	12.72	12	5.24
Offer price revision	<0.01%	244	36%	31%	0.37	683	1%	0%	0.26
Underwriter rank	<0.01%	244	8.67	9.00	0.61	683	7.43	8.00	2.04
Number of managers	<0.01%	244	3.53	3.00	0.76	683	3.17	3.00	1.37
VC dummy	<0.01%	244	0.81	1.00	0.39	683	0.47	0.00	0.50
All-star dummy	<0.01%	244	0.50	0	0.50	683	0.23	0	0.42
Primary dummy	<0.01%	244	0.91	1.00	0.29	683	0.77	1.00	0.42
Age	<0.01%	243	5.98	4.00	7.31	668	10.94	6.00	16.79
Tech dummy	<0.01%	244	0.91	1.00	0.29	683	0.55	1.00	0.50
Internet dummy	<0.01%	244	0.64	1.00	0.48	683	0.30	0.00	0.46
Proceeds ($m)	<0.01%	244	103.65	80.00	96.81	683	110.52	50.00	350.21
Assets ($m)	8.64%	244	65.67	29.25	116.45	671	1280.67	25.20	13638.41
EPS12 ($)	<0.01%	244	-7.91	-1.73	20.37	683	-6.05	-0.42	22.66
Sales ($m)	<0.01%	244	34.53	12.20	98.20	671	274.72	19.30	2362.56
Turnover	<0.01%	244	1.33%	0.95%	1.25%	683	0.95%	0.74%	0.81%
Std. dev. (per day)	<0.01%	244	8.82%	8.60%	1.96%	683	6.51%	6.31%	2.64%

The original IPO sample is from Jay Ritter's IPO database. ADRs, units, spinoffs, reverse LBOs, REITs, Closed-end funds, S&Ls, the stocks that do not have data in the CRSP or TAQ databases, and the stocks whose first trading dates from the CRSP and the TAQ databases are inconsistent are eliminated, leaving a sample of 927 IPO stocks during 1998-2000. Sued IPO firms are charged with laddering. Non-sued IPO firms are not charged with laddering or other issues. Appendix B has the definition of the variables. The Wilcoxon rank-sum test is used to test the difference between the distributions of the non-dummy variables. The comparison of dummy variables is done by Pearson's Chi-square statistic. The two-tailed p-values are shown for either the Wilcoxon test or the Pearson test.

Methods

We will use laddering litigation as a proxy for the existence of laddering to test two of our implications derived earlier. Our Implication 1 states that greater underpricing could lead to more aggressive laddering. Our Implication 4 states that laddering may not necessarily lead to a greater initial return. We will examine the relations between initial return and laddering and test these two implications. Similar to Lowry and Shu (2002), we will use the two-stage probit least squares regression framework (Maddala 1983) to control for potential endogeneity problems.

Two-stage Probit Least Squares Regressions

We use the following two equations to capture the interrelation between initial return and laddering:

$$\text{Test 1}: \quad \textit{Initial Return} = \gamma_1 \, \textit{Laddering} + \theta_1 X + \beta_1 X_1 + \varepsilon_1.$$

$$\text{Test 2}: \quad \textit{Laddering} = \gamma_2 \, \textit{Initial Return} + \theta_2 X + \beta_2 X_2 + \varepsilon_2.$$

In the above two equations, the two primary variables of interest are Initial Return and Laddering. Vector X stands for the control variables that are related to both Initial Return and Laddering. Vector X_1 stands for Initial Return's identifying variables, and Vector X_2 stands for Laddering's identifying variables. In other words, X_1 is only related to Initial Return, but not to Laddering; X_2 is only related to Laddering, but not to Initial Return.

Identifying Variables

We use the prior market return and stock turnover of matched firms as the identifying variables for the initial return and laddering, respectively. These two variables are similar to those in APW. Loughran and Ritter (2002) find that prior market return is

significantly positively related to initial return. Hence we use prior market return to identify initial return. The logic for using turnover of matched firms to identify laddering is similar to that in APW. Our model predicts that a greater expected momentum could lead to more aggressive laddering. Since turnover of matched firms could proxy for the momentum associated with the IPO stock, we argue that it could be used to identify the probability of laddering.

To measure the prior market return, we choose to use the value-weighted NASDAQ Composite's (including distribution) compounded return over the 15 trading days prior to the IPO, since our sample IPOs are primarily from NASDAQ.

We use the GICS codes to select matched firms for the sample firms. All candidate matching firms are CRSP-listed prior to matching.[26] First we select all the firms from the same leftmost six-digit GICS code on the day of the IPO. For the sample firms that are not matched with any control firm, we then select all the firms from the same leftmost four-digit GICS code on the day of the IPO. Finally most (95%) sample firms have a matched firm. Those without a matched firm are not included in the regressions. The turnover and standard deviation of returns of the matched sample are measured over 90 trading days prior to the IPO. The correlation coefficient between the sample firm turnovers and the averages of their matched firm turnovers is 0.20, which is significant at the 0.01% level. The correlation coefficient between the sample firm standard deviations and the averages of their matched firm standard deviations is 0.37, which is significant at the 0.01% level.

[26] We do not restrict the candidate matching firms to those that are listed in CRSP for at least one year for the following two reasons. First, a recent IPO stock's turnover might be able to predict the sample IPO's turnover better. Second, we want to increase the chance of finding a matched firm for our sample firms and preserve our sample size as much as possible.

Control Variables

Our control variables include an all-star analyst dummy, lead underwriter reputation, VC dummy, tech dummy, log (1+age), log (assets), pure primary share dummy, offer price revision, and standard deviation of the returns of the matched firms.[27] In our sample, IPOs are overwhelmingly listed on NASDAQ. Thus, we do not use an exchange dummy as a control variable.

Both anecdotal and systematic evidence indicate that research coverage has become an essential element of the security issuance process in recent years (Dunbar 2000, Clarke, Dunbar, and Kahle 2003, Krigman, Shaw, and Womack 2001, Cliff and Denis 2004). Cliff and Denis (2004) find that IPO underpricing is positively related to the presence of an all-star analyst covering the issuing firm's industry on the research staff of the lead underwriter. Their finding is robust to controls for other determinants of underpricing and to controls for the endogeneity of underpricing and analyst coverage. Therefore, we include an all-star analyst dummy as one of our control variables.

We collect data on *Institutional Investor* (hereafter *II*)'s all-star analyst team and create an all-star dummy variable for each IPO in our sample. An all-star analyst dummy is equal to one if the lead underwriter has an all-star analyst (among the first, second, third, and runner-up teams) in the same industry as the issuer in the year *prior to* the IPO, and zero otherwise. Appendix C contains the details about how we construct this variable.

[27] We use log (assets) instead of market capitalization to avoid the mechanical relation between initial return and market capitalization.

CHAPTER 5
EMPIRICAL RESULTS

We first discuss the regression results without controlling for the endogeneity between initial return and laddering, then examine the relation using a two-stage probit least squares regression framework.

Regression Results without Controlling for Simultaneity

To demonstrate the difference between the regressions with and without controlling for simultaneity, we first estimate an ordinary least squares (OLS) regression in which initial return is the dependant variable, and a probit regression in which a laddering dummy is the dependant variable. Firms are assigned a value of one for the laddering dummy if they have been sued. Table 4 shows the results for the two regressions.

Table 4. IPO Initial Return and Laddering Regressions Results Based on IPOs during 1998-2000 Panel: Regression Results without Controlling for Simultaneity

	OLS			Probit	
Variable	Dep. = IR			Dep. = Laddering	
Intercept	0.001	-0.238**	-0.235**	-5.615***	-5.824***
	0.990	*0.029*	*0.030*	*<0.001*	*<0.001*
Laddering	0.579***	0.747***	0.741***		
	<0.001	*<0.001*	*<0.001*		
IR				0.990***	0.982***
				<0.001	*<0.001*
All-star dummy	0.062	0.092	0.094	0.243*	0.244*
	0.274	*0.135*	*0.127*	*0.082*	*0.081*
Log(Assets)	-0.025**	-0.023*	-0.023*	-0.021	-0.017
	0.038	*0.073*	*0.075*	*0.602*	*0.678*
Offer price revision	1.087***			0.438*	
	<0.001			*0.089*	
Positive offer price revision dummy		0.355***	0.347***		0.401***
		<0.001	*<0.001*		*0.006*
Underwriter rank	0.014	0.012	0.012	0.375***	0.364***
	0.181	*0.312*	*0.284*	*<0.001*	*<0.001*
Tech dummy	0.033	0.101***	0.053	0.462***	0.497***
	0.380	*0.006*	*0.217*	*0.003*	*0.002*
Internet dummy			0.098		
			0.145		
Log(1+age)	0.002	-0.0002	0.007	-0.049	-0.043
	0.892	*0.992*	*0.724*	*0.525*	*0.584*
Pure primary dummy	0.036	0.034	0.032	0.340**	0.345**
	0.336	*0.388*	*0.404*	*0.041*	*0.042*
VC dummy	0.050	0.049	0.046	0.312**	0.321**
	0.269	*0.285*	*0.316*	*0.022*	*0.019*
Standard deviation (control sample)	2.053*	3.345***	2.978**	-0.576	0.239
	0.091	*0.010*	*0.026*	*0.896*	*0.957*
Prior market return	0.988***	1.406***	1.380***		
	<0.001	*<0.001*	*<0.001*		
Turnover (control sample)				52.497**	51.031**
				0.013	*0.014*
Adj. R^2 (or McFadden pseudo R^2)	0.521	0.421	0.423	0.436	0.441
Number of Observations	861	861	861	861	861

The sample consists of 861 IPO firms, among which 240 have been sued for laddering, and 621 have not been sued for laddering or other issues. These regressions test the relations between laddering and initial return using the simultaneous-equation approach, where IR (initial return = (close-offer)/offer) and laddering probability are treated as the endogenous variables. In Panel A, p-values are based on the robust standard errors. In Panel B, Columns 1 and 2 are the first- and second- stage regressions for the effect of laddering on initial return. The first stage is a probit regression, and the second stage is an OLS regression. The second stage laddering instrument in Column 2 equals the fitted value from the first-stage regression. Columns 3 and 4 are the first- and second-stage regressions for the effect of underpricing on laddering. The first stage is an OLS

regression, and the second stage is a probit regression. The IR instrument equals the fitted value from the first-stage regression. All the second stage p-values are based on the standard errors corrected by the methodology in Maddala (1983, p. 245). P-values are reported in italics. An "***", "**", and "*" indicates significance at the 1%, 5%, and 10% levels in two-tailed tests.

In the OLS regression of initial return, the coefficient on the laddering dummy variable is highly significant. However, as we demonstrate in the next subsection, the significance disappears after controlling for simultaneity. Among other independent variables, the two strongest determinants of the initial return are offer price revision and prior market returns. The former is consistent with the partial adjustment phenomenon first documented by Hanley (1993). The latter is consistent with the findings by Loughran and Ritter (2002). Somewhat surprisingly, the coefficient on the lead underwriter reputation rank variable is not significant, and the coefficient on the all-star analyst dummy is not significant. However, as we demonstrate in the next subsection, this is because the highly significant laddering variable in this regression picks up the positive relation. In other words, the endogeneity problem entangles the relations between the independent and dependant variables.

In the probit regression explaining laddering, a higher initial return leads to a statistically significant higher laddering probability. Among other independent variables, the three strongest determinants of laddering are underwriter reputation rank, tech dummy variable, and the positive offer price revision dummy.

Regression Results Controlling for Simultaneity

In this subsection, we control for simultaneity between underpricing and laddering by the two-stage probit least squares regressions. All the second stage standard errors are corrected according to the methodology in Maddala (1983, p. 245).

Table 5 reports the regression results controlling for simultaneity. One thing noteworthy is that the control sample's turnover is highly significant (p-value = 0.5%) in the regression of laddering and insignificant in the regression of initial return, which confirms the validity of the two-stage regressions. As a robustness check, we also measure the control sample's turnover over 30, 60, 120, 150, and 180 trading days prior to the IPO. We find that the control sample's turnover over 30 or 60 trading days prior to the IPO is not a significant identifying variable for laddering. Although the control sample's turnover over 120, 150, or 180 trading days prior to the IPO is a significant identifying variable for laddering, the pseudo R^2 is lower than that produced by using the control sample's turnover over 90 trading days prior to the IPO.

The results reveal two important empirical findings of this study. First, laddering does not contribute to a higher level of initial return, as implied by the insignificant coefficient on the laddering instrument in Column (2). Second, a greater initial return leads a greater probability of laddering, as implied by the significant positive coefficient on the IR instrument in Column (4). The results are consistent with the predictions of our model.

After controlling for simultaneity, the relations between the dependant and independent variables become more disentangled. One can see that the all-star analyst dummy variable is significant for both the initial return regressions in Columns (2) and (3), which is consistent with the view that issuing firms value the presence of an all-star analyst and pay for this prestige via underpricing. The all-star analyst dummy variables are significant and insignificant for the laddering regressions in Columns (1) and (4),

respectively. The significant coefficient in Column (1) might be caused by the relation between underpricing and laddering.

Table 5. IPO Initial Return and Laddering Regressions Results Based on IPOs during 1998-2000 Panel: Simultaneous Equations Results

Variable	Test 1		Test 2	
	First stage dep. = Laddering (1)	Second stage dep. = IR (2)	First stage dep. = IR (3)	Second stage dep. = Laddering (4)
Intercept	-6.101***	-0.349	-0.589***	-5.261***
	<0.001	*0.779*	*<0.001*	*<0.001*
Laddering instrument		0.039		
		0.847		
IR instrument				1.426***
				<0.001
All-star dummy	0.364***	0.180*	0.195***	0.086
	0.004	*0.052*	*0.001*	*0.538*
Log(Assets)	-0.053	-0.024	-0.026	-0.017
	0.264	*0.223*	*0.170*	*0.722*
Positive offer price revision dummy	0.909***	0.479**	0.515***	0.175
	<0.001	*0.016*	*<0.001*	*0.497*
Underwriter rank	0.362***	0.022	0.037**	0.310***
	<0.001	*0.764*	*0.033*	*<0.001*
Tech dummy	0.684***	0.173	0.200***	0.399**
	<0.001	*0.288*	*0.001*	*0.027*
Log(1+age)	-0.031	-0.016	-0.017	-0.007
	0.696	*0.609*	*0.574*	*0.926*
Pure primary dummy	0.439***	0.092	0.109*	0.284*
	0.007	*0.391*	*0.083*	*0.087*
VC dummy	0.365***	0.097	0.111**	0.207
	0.005	*0.283*	*0.046*	*0.129*
Standard deviation (control sample)	7.649*	4.738**	5.040***	0.463
	0.084	*0.098*	*0.004*	*0.920*
Prior market return	2.147***	1.833***	1.943***	
	0.006	*0.007*	*<0.001*	
Turnover (control sample)	37.757**		1.488	35.635*
	0.048		*0.851*	*0.057*
Adj. R^2 (or McFadden pseudo R^2)	0.338	0.297	0.297	0.338
Number of Observations	861	861	861	861

The underwriter reputation rank variable is highly significant (p-value < 0.1%) for the laddering regressions in Columns (1) and (4). The underwriter reputation rank variable is also significant for the regression of initial return in Column (3). The

significance level (3.3%) would be higher (0.3%) if the all-star analyst dummy was not included in the regression, since there is a positive correlation between the underwriter reputation rank and the all-star analyst dummy, consistent with the observation by Cliff and Denis (2004).

In the regression of initial return in Column (2), the underwriter rank variable is not significant, partly due to the positive correlation between underwriter rank and the all-star analyst dummy (correlation coefficient = 21%, with two-tailed p-value<0.01%), and partly due to the fact that the coefficient on the underwriter rank variable in the first stage regression has already picked up the relation (p-value<0.1%).

In Table 6 we use the opening return (i.e., (open-offer)/offer) to replace the initial return in the two-stage regressions in Table 5. This could make a difference since the means/medians of the intraday returns on the first trading day of the IPOs during 1998-2000 are positive, as shown in Figure 3. In other words, the initial returns could be different than the opening returns. However, we find qualitatively similar results.

In Table 7 the sample is screened to only include the IPOs that have positive first-day return and whose market price on 12/6/2000 (i.e., the end of the class period) was lower than the closing price on its first trading day. The results are qualitatively similar.

We then use the opening return to replace the initial return in the two-stage regressions in Table 7, the results are not qualitatively changed.

We also screen the sample to only include the IPOs that have positive first-day return and whose market price on 12/6/2000 was lower than the IPO offer price. We then run the regressions using both initial returns and opening returns. Our findings are robust to these specifications.

Table 6. IPO Opening Return and Laddering Regressions Results Based on IPOs during 1998-2000

Variable	Test 1: First stage dep. = Laddering (1)	Test 1: Second stage dep. = OR (2)	Test 2: First stage dep. = OR (3)	Test 2: Second stage dep. = Laddering (4)
Intercept	-6.101***	0.702	-0.415***	-5.485***
	<0.001	*0.563*	*0.006*	*<0.001*
Laddering instrument		0.183		
		0.357		
OR instrument				1.486***
				0.001
All-star dummy	0.364***	0.127	0.193***	0.077
	0.004	*0.157*	*<0.001*	*0.600*
Log(Assets)	-0.053	-0.015	-0.025	-0.016
	0.264	*0.420*	*0.168*	*0.738*
Positive offer price revision dummy	0.909***	0.324*	0.490***	0.181
	<0.001	*0.092*	*<0.001*	*0.492*
Underwriter rank	0.362***	-0.041	0.025	0.325***
	<0.001	*0.569*	*0.137*	*<0.001*
Tech dummy	0.684***	0.053	0.178***	0.419**
	<0.001	*0.736*	*0.002*	*0.022*
Log(1+age)	-0.031	-0.022	-0.027	0.009
	0.696	*0.474*	*0.347*	*0.909*
Pure primary dummy	0.439***	0.010	0.090	0.305*
	0.007	*0.923*	*0.138*	*0.071*
VC dummy	0.365***	-0.026	0.041	0.304**
	0.005	*0.770*	*0.447*	*0.023*
Standard deviation (control sample)	7.649*	2.071	3.470**	2.492
	0.084	*0.459*	*0.043*	*0.586*
Prior market return	2.770***	1.357**	1.864***	
	<0.001	*0.039*	*<0.001*	
Turnover (control sample)	37.757**		6.908	27.491
	0.048		*0.370*	*0.163*
Adj. R^2 (or McFadden pseudo R^2)	0.338	0.268	0.268	0.338
Number of Observations	861	861	861	861

The only difference between this table and Table 5 is that OR (opening return = (open-offer)/offer) is used here to replace IR in Table 5.

Table 7. IPO Initial Return and Laddering Regressions Results Based on IPOs during 1998-2000 with Positive First-day Return and Market Price on 12/6/2000 Lower than the Closing Price on the First Trading Day

Variable	Test 1: First stage dep. = Laddering (1)	Test 1: Second stage dep. = IR (2)	Test 2: First stage dep. = IR (3)	Test 2: Second stage dep. = Laddering (4)
Intercept	-5.492***	-0.433	-0.676***	-4.692***
	<0.001	*0.753*	*0.002*	*<0.001*
Laddering instrument		0.044		
		0.860		
IR instrument				1.183***
				0.002
All-star dummy	0.550***	0.257	0.281***	0.217
	<0.001	*0.104*	*<0.001*	*0.198*
Log(Assets)	-0.036	-0.028	-0.030	-0.001
	0.517	*0.302*	*0.295*	*0.983*
Positive offer price revision dummy	0.699***	0.398**	0.429***	0.192
	<0.001	*0.048*	*<0.001*	*0.412*
Underwriter rank	0.319***	0.023	0.037	0.275***
	<0.001	*0.779*	*0.152*	*<0.001*
Tech dummy	0.599***	0.240	0.267***	0.284
	0.001	*0.191*	*0.002*	*0.184*
Log(1+age)	-0.027	-0.021	-0.022	-0.0005
	0.772	*0.644*	*0.625*	*0.995*
Pure primary dummy	0.524***	0.170	0.194**	0.295*
	0.005	*0.266*	*0.031*	*0.135*
VC dummy	0.446***	0.130	0.150*	0.269*
	0.003	*0.334*	*0.062*	*0.078*
Standard deviation (control sample)	5.151	6.052*	6.281**	-2.281
	0.305	*0.073*	*0.014*	*0.665*
Prior market return	2.842***	2.276**	2.402***	
	0.003	*0.012*	*<0.001*	
Turnover (control sample)	43.243**		1.917	40.975*
	0.048		*0.864*	*0.057*
Adj. R^2 (or McFadden pseudo R^2)	0.301	0.258	0.268	0.338
Number of Observations	565	565	565	565

The only difference between this table and Table 5 is that the sample is screened to only include the IPOs that have positive first-day return and whose market price on 12/6/2000 (i.e., the end of the class period) was lower than the closing price on its first trading day.

Summary and Discussion

This section tests our Implications 1 and 4 by investigating the relations between initial return and laddering, controlling for the potential endogeneity problem between the two variables. We find supporting evidence for both implications. The first finding is that laddering does not lead to a greater initial return, contrary to the finding in APW. Although APW uses a similar instrumental variable regression to study the issue, there are some differences between the exact methods used. For example, they select the control firms by a different method; the way they calculate the control firms' turnover is different; the control variables used in their regressions are fewer than ours. The exact reasons for the contradicting results demand further investigation.

This finding has important implications for the IPO literature. First, as long as the equilibrium aftermarket price of the IPO stock is no higher than the fundamental value of the stock and the momentum effect is not exploding, laddering would not increase the offer price above the fundamental value of the stock. More importantly, it could help the issuing firm to reduce the information associated with raising equity capital, although obviously it also hurts the benefit of the aftermarket investors who buy shares at inflated prices. Second, laddering may not significantly weaken the statistical power of regressions of initial returns.

The second finding is that IPOs with greater initial returns exhibit a greater probability of laddering. This tells investors that IPOs with characteristics that are positively related to greater underpricing could have a higher probability of laddering. This implication is important for aftermarket investors' investment decision making.

Our interpretation of the empirical results is based on the assumption that the likelihood of laddering is correlated with the laddering litigation. We have tried to control

for the possibility that some IPOs could be sued simply because of a higher chance of winning the suit by the plaintiffs. First, assuming that the opening price on the first trading day of IPO is less influenced by ladderers and noise traders and better represents the expected aftermarket price without laddering, we use the opening return to replace the initial return in our regressions. Second, we screen our sample to only include the IPOs that exhibit a rising and declining price pattern, which is a triggering event for securities litigation. However, these cannot exclude the alternative explanation that plaintiff lawyers sort suits to have a higher chance of winning. Therefore, the results should be interpreted with caution.

CHAPTER 6
CONCLUSION

Laddering involves purchasing additional shares in the aftermarket in return for IPO allocations. This dissertation presents a formal model of laddering and explores the driving forces behind laddering and the impact of laddering on IPO pricing and the aftermarket price of the shares. Empirical implications of the model are generated and supported by empirical tests and existing evidence.

We predict that more expected underpricing (without laddering) and information momentum each contribute to a greater extent of laddering and hence the magnitude of laddering-induced immediate aftermarket price inflation. If the underwriter benefits from rent-seeking behavior by its investor clients, then laddering could bring additional benefit to the underwriter, which implies that profit-sharing between underwriters and their investor clients could encourage laddering.

We argue that laddering could influence the underwriter's choice of the IPO offer price. By reducing the expected price support cost, laddering tends to increase the offer price, which is confirmed by the evidence that IPOs sued for laddering have significantly higher offer prices than the non-sued IPOs, and sued IPOs are significantly more overvalued than non-sued IPOs based on the offer price-to-fundamental value ratios.

We also predict that laddering may not increase the first-day return, because it depends on the relative magnitude by which the offer price and the first-day close price are boosted by laddering. This has important implication for the IPO underpricing literature.

Our model implies that by boosting the immediate aftermarket price above its equilibrium level, laddering contributes to long-run underperformance and a negative correlation between short-run and long-run returns. Even though laddering by itself may not boost the short-run returns, there will be more laddering on IPOs with high expected first-day returns (without laddering). Therefore, IPOs with high expected first-day returns (without laddering) would have more severe long-run underperformance, resulting in a negative correlation between short-run and long-run returns.

We find empirical evidence supporting our predictions, based on IPOs during 1998-2000. First, laddering does not explain the high level of the first-day return, after controlling for the endogeneity issue between the first-day return and laddering, market condition (prior market return), underwriter characteristics (reputation and all-star analyst), issuer characteristics (technology firm, VC backed, assets, and age), and offer characteristics (pure primary offer and offer price revision). Second, a greater first-day return leads to a greater probability of laddering, after controlling for the above factors. The results are robust to using the first-day opening return (i.e., (open–offer)/offer) to replace the first-day return, although the means/medians of the intraday returns (i.e., (close–open)/open) on the first trading day of IPOs during 1999-2000 are positive. The results shed light on the relations between laddering and IPO underpricing.

APPENDIX A
PROOFS OF THE MAIN RESULTS

Proof of Proposition 1. In the case where there is laddering but no profit-sharing, the underwriter solves the following problem:

$$\max_{P_0, q_L, \lambda} E(\widetilde{\Pi}_{U2}) \equiv E_{\hat{P}_E}\{cP_0 - E_{\widetilde{P}_1}(\text{price support cost } |\hat{P}_E)\}, \tag{14}$$

s.t.

$$E(\widetilde{\Pi}_L) = [P_E - P_0] + [P_E - P_1]\lambda \geq 0. \tag{6}$$

We can rewrite (14) as

$$\max_{P_0, \lambda, q_L} E(\widetilde{\Pi}_{U2}) \equiv E_{\hat{P}_E}\left\{cP_0 - \frac{1}{2\Delta}\left[P_0 - (\hat{P}_E + w(1+\lambda)bq_L - \frac{\Delta}{2})\right]^2\right\}$$

$$= E_\varepsilon\left\{cP_0 - \frac{1}{2\Delta}\left[P_0 - (P_E + \varepsilon + w(1+\lambda)bq_L - \frac{\Delta}{2})\right]^2\right\}$$

$$= cP_0 - \frac{1}{2\Delta}\left[P_0 - (P_E + w(1+\lambda)bq_L - \frac{\Delta}{2})\right]^2 - \frac{1}{2\Delta}f(Q_0 - q_L). \tag{16}$$

Taking the derivative w.r.t. q_L at the optimum offer price for $E(\widetilde{\Pi}_{U1})$, without laddering, we get

$$\left.\frac{\partial E(\widetilde{\Pi}_{U2})}{\partial q_L}\right|_{P_0 = P_E - \Delta(\frac{1}{2} - c), q_L = 0, \lambda = 0} = \frac{b}{\Delta}c + \frac{1}{2\Delta}f'(Q_0)$$

The above derivative must be greater than zero in order to motivate the underwriter to allocate shares to the ladderer. In other words, the underwriter would like to allocate

shares to the ladderer when the marginal value of the information from the informed investors satisfies the following condition,

$$-f'(Q_0) \le 2cb. \qquad \#$$

Constraint (6) suggests that when $V - P_0 \le 0$, $q_L = 0$. In other words, underpricing is a necessary condition for laddering to exist, when there is no price momentum. #

Proof of Proposition 2. From (16), the first order condition w.r.t. the offer price suggests

$$P_0^* = P_E + wb(1+\lambda)q_L - \Delta(\frac{1}{2} - c). \tag{A1}$$

Substituting (A1) back into (16) yields

$$\max_{P_0, \lambda, q_L} \left\{ c[P_E + wb(1+\lambda)q_L - \Delta(\frac{1}{2} - c)] - \frac{1}{2\Delta}(\Delta c)^2 - \frac{1}{2\Delta} f(Q_0 - q_L) \right\}. \tag{A2}$$

The problem in (A2) gives first-order condition w.r.t. q_L,

$$cw(1+\lambda)b + \frac{1}{2\Delta} f'(Q_0 - q_L) = 0 \ , \tag{A3}$$

which implies that q_L increases in λ. Taking the first derivative w.r.t. λ in (A2) yields

$$\frac{\partial E\tilde{\Pi}_{U2}}{\partial \lambda} = wcbq_L > 0, \text{ if } q_L > 0. \tag{A4}$$

This indicates that a greater λ is preferred by the underwriter if $q_L > 0$ and $w > 0$. Substituting (A1) into (6) we get

$$\Delta(\frac{1}{2} - c) - wb(1+\lambda)^2 q_L \ge 0, \tag{A5}$$

which limits λ upwards. Therefore, we know if $q_L > 0$ and $w > 0$, then the constraint in (6) will bind,

$$(1+\lambda)^2 wbq_L = \Delta(\frac{1}{2} - c). \tag{A6}$$

Note that the level of laddering could be measured by $(1+\lambda)q_L$, and underpricing without laddering is $\Delta(\frac{1}{2} - c)$. Let $x = \Delta(\frac{1}{2} - c)$. If we can prove that $\frac{dq_L}{dx} > 0$ and $\frac{d\lambda}{dx} > 0$, then we can conclude that $(1+\lambda)q_L$ increases with *x*, i.e., laddering increases with the underpricing without laddering. We will prove them below.

Proof of $\frac{dq_L}{dx} > 0$:

From (A6) we have $(1+\lambda) = \sqrt{\frac{x}{wbq_L}}$. Substituting it into (A3) yields

$$cb\sqrt{\frac{x}{wbq_L}} + \frac{1}{2\Delta} f'(Q_0 - q_L) = 0,$$

i.e.,
$$c^2 wbx - \frac{1}{4\Delta^2} q_L [f'(Q_0 - q_L)]^2 = 0.$$

Taking the first derivative w.r.t. *x* yields

$$c^2 wb - \frac{1}{4\Delta^2}\left[\frac{\partial q_L}{\partial x} \cdot [f'(Q_0 - q_L)]^2 - 2f'(Q_0 - q_L) q_L f''(Q_0 - q_L)\frac{\partial q_L}{\partial x}\right] = 0,$$

i.e,
$$\frac{\partial q_L}{\partial x} = \frac{4\Delta^2 c^2 bw}{[f'(Q_0 - q_L)]^2 - 2q_L f'(Q_0 - q_L) f''(Q_0 - q_L)}.$$

Since $f'(Q_0 - q_L) < 0$ and $f''(Q_0 - q_L) > 0$, we have $\frac{\partial q_L}{\partial x} > 0$. #

Proof of $\frac{d\lambda}{dx} > 0$:

From the binding constraint in (A6) we have $q_L = \frac{x}{b(1+\lambda)^2}$. Substituting it back into (A3) yields

$$c(1+\lambda)bw + \frac{1}{2\Delta} f'(Q_0 - \frac{x}{bw(1+\lambda)^2}) = 0$$

Taking the first derivative w.r.t. x yields

$$cbw\frac{\partial\lambda}{\partial x} + \frac{1}{2\Delta} f''(Q_0 - \frac{x}{bw(1+\lambda)^2}) \frac{2xbw(1+\lambda)\frac{\partial\lambda}{\partial x} - bw(1+\lambda)^2}{[bw(1+\lambda)^2]^2} = 0,$$

i.e.,

$$\frac{\partial\lambda}{\partial x} = \frac{\dfrac{f''(Q_0 - \frac{x}{bw(1+\lambda)^2})}{2\Delta bw(1+\lambda)^2}}{cb + \dfrac{f''(Q_0 - \frac{x}{bw(1+\lambda)^2})xbw(1+\lambda)}{\Delta[bw(1+\lambda)^2]^2}}.$$

Since $f''(Q_0 - \frac{x}{bw(1+\lambda)}) > 0$, we know $\frac{\partial\lambda}{\partial x} > 0$. #

Proof of Proposition 3. When there could be profit-sharing, the underwriter solves the following problem,

$$\max_{P_0, q_k} E(\widetilde{\Pi}_{U3})$$
$$\equiv E_{\hat{P}_E}\left\{cP_0 - E_{\widetilde{P}_1}(\text{price support cost } |\hat{P}_E) + E_{\widetilde{P}_1}(\text{profit from profit - sharers } |\hat{P}_E)\right\} \tag{18}$$

which can be rewritten as

$$\max_{P_0,q_k}\left\{cP_0-\frac{1}{2\Delta}\left[P_0-(P_E-\frac{\Delta}{2})\right]^2+\frac{kq_k}{2\Delta}\left(P_E-P_0+\frac{\Delta}{2}\right)^2-\frac{(1-kq_k)}{2\Delta}f(Q_0-q_K)\right\}. \quad (20)$$

Taking the derivative w.r.t. q_K at the optimum offer price in case one, we get

$$\left.\frac{\partial E(\tilde{\Pi}_{U3})}{\partial q_k}\right|_{P_0=P_E+\Delta(\frac{1}{2}-c),q_k=0}=\frac{k}{2\Delta}(\Delta(1-c))^2+\frac{k}{2\Delta}f(Q_0)+\frac{1}{2\Delta}f^{'}(Q_0).$$

The above derivative must be greater than zero in order to motivate the underwriter to allocate shares to the profit-sharers. In other words, the underwriter would like to allocate shares to the profit-sharers when the marginal value of the information from the informed investors satisfies the following condition,

$$-f^{'}(Q_0)\le k\{[\Delta(1-c)]^2+f(Q_0)\}. \qquad \#$$

Proof of Proposition 4. From (20), taking the derivative w.r.t. P_0 at the optimum offer price for $E\tilde{\Pi}_{U1}$, we get $\left.\frac{\partial E\tilde{\Pi}_{U3}}{\partial P_0}\right|_{P_0=P_E-\Delta(\frac{1}{2}-c)}=kq_k(c-1)<0$. Hence, the offer price maximizing $E\tilde{\Pi}_{U3}$ is smaller than that maximizing $E\tilde{\Pi}_{U1}$. #

From (24), taking the derivative w.r.t. P_0 at the optimum offer price for $E\tilde{\Pi}_{U2}$, we get $\left.\frac{\partial E\tilde{\Pi}_{U4}}{\partial P_0}\right|_{P_0=P_E+wb(1+\lambda)q_L-\Delta(\frac{1}{2}-c)}=-kq_K(1-c)<0$. Hence, the offer price maximizing $E\tilde{\Pi}_{U4}$ is smaller than that maximizing $E\tilde{\Pi}_{U2}$. #

Since $\frac{\partial(\lambda q_L)}{\partial P_0}<0$ and $\frac{\partial P_0}{\partial k}<0$, we have $\frac{\partial(\lambda q_L)}{\partial k}>0$. #

Proof of Proposition 5. Comparing (A1) and (10), it is obvious that if $q_L > 0$ and $w > 0$, the offer price will be increased by laddering. #

From (20), the first order condition w.r.t. P_0 gives the following condition,

$$c - \frac{1}{\Delta}[P_0 - (P_E - \frac{\Delta}{2})] - \frac{kq_k}{\Delta}[P_E - P_0 + \frac{\Delta}{2}] = 0. \tag{A7}$$

From (24), the first derivative w.r.t. P_0 is

$$\frac{\partial E\tilde{\Pi}_{U4}}{\partial P_0} = c - \frac{1}{\Delta}[P_0 - (P_E + (1+\lambda)wbq_L - \frac{\Delta}{2})] - \frac{kq_K}{\Delta}[P_E + (1+\lambda)bq_L - P_0 + \frac{\Delta}{2}].$$

Substituting equation (A7) into the above equation, we have

$$\frac{\partial E\tilde{\Pi}_{U4}}{\partial P_0} = \frac{(w - kq_K)}{\Delta}(1+\lambda)bq_L.$$

Therefore, if $q_L > 0$, and $w > kq_K$, then $\frac{\partial E\tilde{\Pi}_{U4}}{\partial P_0} = \frac{(w - kq_K)}{\Delta}(1+\lambda)bq_L > 0$, i.e., the offer price maximizing $E\tilde{\Pi}_{U4}$ is greater than that maximizing $E\tilde{\Pi}_{U3}$. #

The first-day return with laddering is measured by

$\frac{\tilde{P}_E + (1+\lambda)bq_L - [P_0 + w(1+\lambda)bq_L]}{P_0 + w(1+\lambda)bq_L}$. The first-day return without laddering is measured by $\frac{\tilde{P}_E - P_0}{P_0}$. It is straightforward to show that laddering increases (decreases) the first-day return if $w < (>) \frac{P_0}{P_E}$. #

Proof of Proposition 6. Consider the second case, where there is laddering without profit-sharing. If there is information momentum, then ladderers' participation constraint

becomes (25). Since $E(M(\Delta\widetilde{P})) \geq mE(\Delta\widetilde{P})$, we can use $mE(\Delta\widetilde{P})$ as a lower bound for $E(M(\Delta\widetilde{P}))$ to approximate our results. Substituting (A1) into (25) gives

$$\Delta(\frac{1}{2}-c) - bw(1+\lambda)^2 q_L + (1+\lambda)m\Delta(\frac{1}{2}-c) \geq 0. \tag{A8}$$

Letting (A8) bind gives

$$q_L = \frac{\Delta(\frac{1}{2}-c) + (1+\lambda)m\Delta(\frac{1}{2}-c)}{bw(1+\lambda)^2} = \frac{\Delta(\frac{1}{2}-c)}{bw(1+\lambda)^2} + \frac{m\Delta(\frac{1}{2}-c)}{bw(1+\lambda)}. \tag{A9}$$

Substituting (A9) into (A3) yields

$$c(1+\lambda)bw + \frac{1}{2\Delta} f'\left(Q_0 - \frac{\Delta(\frac{1}{2}-c)}{bw(1+\lambda)^2} - \frac{m\Delta(\frac{1}{2}-c)}{bw(1+\lambda)} \right) = 0, \tag{A10}$$

which could be used to solve for the optimal λ when there is momentum. When *m=0*, (A10) becomes

$$c(1+\lambda^*)bw + \frac{1}{2\Delta} f'\left(Q_0 - \frac{\Delta(\frac{1}{2}-c)}{bw(1+\lambda^*)^2} \right) = 0, \tag{A11}$$

which contains the optimal λ when there is no momentum. Next we will prove that the λ that solves (A10) when *m>0* is greater than the λ that solves (A11). Since $-\frac{m\Delta(\frac{1}{2}-c)}{bw(1+\lambda)} < 0$, if we substitute the solution λ^* for (A11) into the left hand side of equation (A10), we have

$$c(1+\lambda^*)bw + \frac{1}{2\Delta} f'\left(Q_0 - \frac{\Delta(\frac{1}{2}-c)}{bw(1+\lambda^*)^2} - \frac{m\Delta(\frac{1}{2}-c)}{bw(1+\lambda^*)} \right) < 0. \tag{A12}$$

Since λ^* in (A12) needs to be increased to obtain the equality in (A10), the momentum effect scalar m changing from zero to positive would increase λ. Similarly we can show that λ increases in m in general. #

Next we will prove that the optimal q_L when *m>0* is greater than that when *m=0.* From (A3) we have $(1+\lambda) = -\frac{f'(Q_0 - q_L)}{2\Delta cbw}$. Substituting it into (A8) and letting (A8) bind yields

$$\Delta(\frac{1}{2}-c) - bwq_L\left(\frac{f'(Q_0 - q_L)}{2\Delta cbw}\right)^2 - \frac{f'(Q_0 - q_L)}{2\Delta cbw}m\Delta(\frac{1}{2}-c) = 0. \qquad \text{(A13)}$$

When m=0, (A13) becomes

$$\Delta(\frac{1}{2}-c) - bwq_L^*\left(\frac{f'(Q_0 - q_L^*)}{2\Delta cbw}\right)^2 = 0. \qquad \text{(A14)}$$

We need to prove that the q_L that solves (A13) when m>0 is greater than the q_L that solves (A14). Since $-\frac{f'(Q_0 - q_L^*)}{2\Delta cbw}m\Delta(\frac{1}{2}-c) > 0$, if we substitute the solution q_L^* from (A14) into the left hand side of equation (A13), we have

$$\Delta(\frac{1}{2}-c) - bwq_L^*\left(\frac{f'(Q_0 - q_L^*)}{2\Delta cbw}\right)^2 - \frac{f'(Q_0 - q_L^*)}{2\Delta cbw}m\Delta(\frac{1}{2}-c) > 0. \qquad \text{(A15)}$$

Since q_L^* in (A15) needs to be increased to obtain the equality in (A13), we know that q_L^* will be increased when the momentum effect changes from zero to positive. Similarly, we can show that q_L increases in m in general. #

APPENDIX B
DEFINITION OF VARIABLES

1. **Initial return** = (Closing price-offer price)/offer price on the first trading day of IPO.
2. **Opening return** = (Opening price on the first trading day of IPO -offer price)/offer price.
3. **Intraday return** = (Closing price-opening price)/opening price on the first trading day of IPO.
4. **Offer price revision** = (offer price –midpoint of the file price range)/ midpoint of the file price range.
5. **Positive offer price revision dummy:** a dummy variable equal to one if the offer price is higher than the midpoint of the file price range, and zero otherwise.
6. **Underwriter rank**: IPO lead underwriter reputation ranks, downloadable from Jay Ritter's website at http://bear.cba.ufl.edu/ritter/Rank.htm.
7. **Number of managers**: the number of managers, including domestic lead, co-lead and co-managers.
8. **VC dummy**: a dummy variable equal to one if the firm is venture capitalists backed, and zero otherwise.
9. **Primary dummy**: a dummy variable equal to one if 100% of primary shares offered out of total shares offered, and zero otherwise.
10. **Age** = IPO year - founding year.
11. **Internet dummy**: a dummy variable equal to one if the firm is in an internet firm (SDC High-Tech variable HITECHP = 420), and zero otherwise.

12. **Tech dummy**: a dummy variable equal to one if the firm is in a high-tech industry (SICs 3570, 3571, 3572, 3575, 3577, 3578, 3660, 3661, 3663, 3669, 3674, 3810, 3812, 3820, 3823, 3825, 3826, 3827, 3829, 3840, 3841, 3845, 4812, 4813, 4899, 7370, 7371, 7372, 7373, 7374, 7375, 7378, 7379, or internet dummy=1), and zero otherwise.
13. **Proceeds**: global proceeds (in US $ millions).
14. **Assets**: total assets before offering (in US $ millions).
15. **EPS12**: earning per share for last 12 month period.
16. **Sales**: total revenues for last 12 month period (in US $ millions).
17. **Turnover**: (1)For the sample IPO firms, it is the average share turnover over 90 trading days after the IPO date, as defined in equation (26). (2) For the control firms, it is the average share turnover over 90 trading days prior to the IPO date of the sample IPO firms. We adjust for the Nasdaq volume definition by dividing Nasdaq volume by a factor of two.
18. **Standard deviation**: (1) For the sample IPO firms, it is the standard deviation of the returns over 90 trading days after the IPO date. (2) For the control firms, it is the standard deviation of the returns over 90 trading days prior to the IPO date of the sample IPO firms.
19. **Prior market return**: value-weighted Nasdaq Composite (including distribution)'s compounded return over the 15 trading days prior to IPO.
20. **All-star dummy**: a dummy variable equal to one if the lead underwriter has an all-star analyst in the same industry as the issuer in the year prior to the IPO, and zero otherwise. An all-star is defined as all the teams mentioned on *Institutional Investor*'s

all-star analyst team list in the October issue, including the first, second, third, and runner-up teams.

APPENDIX C
CONSTRUCTION OF THE ALL-STAR DUMMY VARIABLE

Our definition of an all-star analyst dummy is different than that in Cliff and Denis (2004) along two dimensions. First, we do not set the all-star analyst dummy to one if the lead analyst is on *II*'s all-star research team list in the IPO year only, while Cliff and Denis do.[28] Second, we consider all the first, second, third, and runner-up teams mentioned on *II* as all-star analyst teams, while Cliff and Denis only include the top three teams.[29] The first difference alone would make us have fewer all-star analyst dummies than Cliff and Denis, while the second difference alone would make us have more all-star analyst dummies than them. In the regressions presented in the next section, the results are qualitatively the same regardless whether we include or exclude the runners-up.

We do not rely on the SIC code to decide if an IPO firm is in the same industry as its lead underwriter's analyst for the following two reasons. First, during 1998-2000, many internet, e-commerce, and new media firms went public. *II* updates its industry classifications every year and added these new industries. For example, for years 1997, 1998, 1999, and 2000, *II* uses 72, 79, 81, and 73 industries, respectively. One thing noteworthy is that the SIC code does not accurately reflect whether a firm belongs to

[28] We do not use the all-star research team list published in the IPO year for the following reason. Since *II* publishes its all-America research team list in its October's issue, IPOs from January-September could not have known who would be an all-star in October. Furthermore, the lead underwriter or underwriters are typically picked a few months before going public, so it is plausible that almost all of the lead underwriters for IPOs in the IPO year were picked using information based on the rankings in the prior year.

[29] We include runners-up for the following reasons. First, the correlation between the all-star analyst dummy and underpricing is higher including runners-up than excluding runners-up. Second, the adjusted R^2 for the underpricing regressions is higher including runners-up than excluding runners-up.

these new industries. For example, Healtheon Corp., which went public on 2/10/1999, is classified into both the internet and health care industries in analyst reports. However, its SIC code 7374 indicates that the industry is data processing and preparation, which by no means tells us that we could confidently classify it into internet and health care.

Second, although the four-digit SIC code results in many more industries than *II*, sometimes the industry description based on the SIC code is still too broad to tell which *II* defined industry it corresponds to. For example, SIC code 3674 refers to semiconductors and related devices. However, in our sample, firms with this SIC code could be classified into one of the following *II* defined industries: semiconductor capital equipment, semiconductor devices, wireless equipment, or internet infrastructure and services.

Therefore, for IPOs whose lead underwriter has an all-star analyst, we hand check all the initiating coverage reports by various investment banks as well as the coverage by *The IPO Reporter* and *IPO Maven* in the *Investext Plus* database to decide on the IPO firm's industry. A major advantage of this method is that the industries proposed by *II* are very close to the industries classified by the analyst reports. Therefore, hand checking the analyst reports can provide a highly accurate industry classification. If an IPO firm is considered as belonging to more than one *II* defined industries, as suggested by analyst reports, we will define the firm as having a lead all-star analyst if its lead underwriter's analyst is an all-star in either of the industries. As a result, 29% of our sample IPOs have an all-star analyst.[30]

[30] As a comparison, Cliff and Denis (2004) report that 39.9% of their sample IPOs from 1998-2000 have an all-star analyst. Note that their sample only includes the IPOs for which a subsequent SEO is made by 2001.

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I certify that I have read this study and that in my opinion it conforms to acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

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